INSTALLATION MANUAL

HIGH EFFICIENCY
TUBULAR HEAT EXCHANGER SERIES
MODELS: PC9*DH, FC9C*DH, FL9C*DH
(Modulating Downflow/Horizontal with ECM Motor)
60 - 120 MBH INPUT
(17.6 - 35.2 KW) INPUT

ISO 9001
Certified Quality
Management System

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SECTION I: FURNACE DESCRIPTION

This furnace is a modulating furnace. It is designed to maximize the comfort in the home and to minimize the sound level in the home by varying (modulating) the gas input and the circulating airflow to closely match the amount of heating needed at any given time.

SECTION II: SAFETY

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention to the signal words **DANGER**, **WARNING**, or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury**.

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury**.

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.
Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠ CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state, and national codes including, but not limited to building, electrical, and mechanical codes.

SPECIFIC SAFETY RULES AND PRECAUTIONS

1. Only Natural gas or Propane (LP) gas are approved for use with this furnace. Refer to the furnace rating plate or Section V of these instructions.
2. Install this furnace only in a location and position as specified below.
3. A gas-fired furnace for installation in a residential garage must be installed as specified in Section II of these instructions.
4. Provide adequate combustion and ventilation air to the furnace space as specified in Section VII of these instructions.
5. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in Section VII of these instructions.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

6. Tests for gas leaks as specified in Section X of these instructions.
7. Always install the furnace to operate within the furnace's intended temperature rise range. Only connect the furnace to a duct system which has an external static pressure within the allowable range, as specified on the furnace rating plate.
8. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
9. It is permitted to use the furnace for heating of buildings or structures under construction. Installation must comply with all manufacturer's installation instructions including:
   - Proper vent installation;
   - Furnace operating under thermostatic control;
   - Return air duct sealed to the furnace;
   - Air filters in place;
   - Set furnace input rate and temperature rise per rating plate marking;
   - Means for providing outdoor air required for combustion;
   - Return air temperature maintained between 55ºF (13ºC) and 80ºF (27ºC);
   - The **air filter must be replaced** upon substantial completion of the construction process;
   - Clean furnace, duct work and components upon substantial completion of the construction process, and verify furnace-operating conditions including ignition, input rate, temperature rise and venting, according to the manufacturer's instructions.
10. When installed in a Non-HUD-Approved Modular Home or building constructed on-site, combustion air shall not be supplied from occupied spaces.
11. The size of the unit should be based on an acceptable heat loss calculation for the structure. ACCA, Manual J or other approved methods may be used.

SAFETY REQUIREMENTS

- This furnace should be installed in accordance with all national and local building/safety codes and requirements, local plumbing or wastewater codes, and other applicable codes. In the absence of local codes, install in accordance with the National Fuel Gas Code ANSI Z223.1/NFPA 54, National Fuel Gas Code, and/or CAN/CGA B149.1 Natural Gas and Propane Installation Code (latest editions). Furnaces have been certified to the latest edition of standard ANSI Z21-47 • CSA 2.3.
- Refer to the unit rating plate for the furnace model number, and then see the dimensions page of this instruction for return air plenum dimensions in Figure 3. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed under Clearances to Combustibles in Table 1.
- Provide clearances for servicing ensuring that service access is allowed for both the burners and blower.
- These models **ARE NOT** CSA listed or approved for installation into a **HUD Approved Modular Home** or a **Manufactured (Mobile) Home**.
- This furnace is not approved for installation in trailers or recreational vehicles.
- **Failure to carefully read and follow all instructions in this manual can result in furnace malfunction, death, personal injury and/or property damage.**
- Furnaces for installation on combustible flooring shall not be installed directly on carpeting, tile or other combustible material other than wood flooring.
- Check the rating plate and power supply to be sure that the electrical characteristics match. All models use nominal 115 VAC, 1 Phase, 60-Hertz power supply. DO NOT CONNECT THIS APPLIANCE TO A 50 HZ POWER SUPPLY OR A VOLTAGE ABOVE 130 VOLTS.
- Furnace shall be installed so the electrical components are protected from water.
- Installing and servicing heating equipment can be hazardous due to the electrical components and the gas fired components. Only trained and qualified personnel should install, repair, or service gas heating equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.
- These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances these instructions exceed certain local codes and ordinances, especially those which have not kept up with changing residential and non-HUD modular home construction practices. These instructions are required as a minimum for a safe installation.

COMBUSTION AIR QUALITY (LIST OF CONTAMINANTS)

The furnace will require **OUTDOOR AIR** for combustion when the furnace is located in any of the following environments.

- Restricted Environments
- Commercial buildings
- Buildings with indoor pools
- Furnaces installed in laundry rooms
- Furnaces installed in hobby or craft rooms
- Furnaces installed near chemical storage areas
- Chemical Exposure

The furnace will require **OUTDOOR AIR** for combustion when the furnace is located in an area where the furnace is being exposed to the following substances and / or chemicals.

- Permanent wave solutions
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- De-icing salts or chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (such as perchloroethylene)
- Printing inks, paint removers, varnishes, etc.
- Hydrochloric acid
- Cements and glues
- Antistatic fabric softeners for clothes dryers
- Masonry acid washing materials

When outdoor air is used for combustion, the combustion air intake pipe termination must be located external to the building and in an area where there will be no exposure to the substances listed above.

⚠WARNING

The furnace area must not be used as a broom closet or for any other storage purposes, as a fire hazard may be created. Never store items such as the following on, near, or in contact with the furnace.

1. Spray or aerosol cans, rags, brooms, dust mops, vacuum cleaners or other cleaning tools.
2. Soap powders, bleaches, waxes or other cleaning compounds; plastic items or containers; gasoline, kerosene, cigarette lighter fluid, dry cleaning fluids or other volatile fluid.
3. Paint thinners and other painting compounds.
4. Paper bags, boxes or other paper products

Never operate the furnace with the blower door removed. To do so could result in serious personal injury and/or equipment damage.

FOR FURNACES INSTALLED IN THE COMMONWEALTH OF MASSACHUSETTS ONLY

For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

1. **INSTALLATION OF CARBON MONOXIDE DETECTORS.** At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors
   a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.
   b. In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.
2. **APPROVED CARBON MONOXIDE DETECTORS.** Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.
3. **SIGNAGE.** A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, "**GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS**".
4. **INSPECTION.** The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

INSPECTION

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing. Also, before installation the unit should be checked for screws or bolts, which may have loosened in transit. There are no shipping or spacer brackets which need to be removed.

FURNACE LOCATION AND CLEARANCES

The furnace shall be located using the following guidelines:

1. Where a minimum amount of air intake/vent piping and elbows will be required.
2. As centralized with the air distribution as possible.
3. Where adequate combustion air will be available (particularly when the appliance is not using outdoor combustion air).
4. Where it will not interfere with proper air circulation in the confined space.
5. Where the outdoor combustion air/vent terminal will not be blocked or restricted. Refer to See "COMBUSTION AIR / VENT CLEARANCES" on Page 14. located in Section VII of these instructions. These minimum clearances must be maintained in the installation.
6. Where the unit will be installed in a level position with no more than 1/4" (6.4 mm) slope side-to-side and front-to-back to provide proper condensate drainage.

Installation in freezing temperatures:

1. Furnace shall be installed in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures must not fall below 32°F (0°C) unless the condensate system is protected from freezing.
2. Do not allow return air temperature to be below 55º F (13° C) for extended periods. To do so may cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure, leading to premature heat exchanger failure.

⚠WARNING

Improper installation in an ambient below 32ºF (0.0° C) could create a hazard, resulting in damage, injury or death.

3. If this furnace is installed in any area where the ambient temperature may drop below 32° F (0° C), a UL listed self-regulated heat tape must be installed on any condensate drain lines. It is recommended that self regulating heat tape rated at least 3 watts per foot be used. This must be installed around the condensate drain lines in the unconditioned space. Always install the heat tape per the manufacturer's instructions. Cover the self-regulating heat tape with fiberglass, Armaflex or other heat resistant insulating material.
4. If this unit is installed in an unconditioned space and an extended power failure occurs, there will be potential damage to the condensate trap, drain lines and internal unit components. Following a power failure situation, do not operate the unit until inspection and repairs are performed.

Clearances for access:

Ample clearances should be provided to permit easy access to the unit. The following minimum clearances are recommended:

1. Twenty-four (24) inches (61 cm) between the front of the furnace and an adjacent wall or another appliance, when access is required for servicing and cleaning.
2. Eighteen (18) inches (46 cm) at the side where access is required for passage to the front when servicing or for inspection or replacement of flue/vent connections.

In all cases, accessibility clearances shall take precedence over clearances for combustible materials where accessibility clearances are greater.

⚠WARNING

Downflow/Horizontal furnaces for installation on combustible flooring only when installed on the accessory combustible floor base on wood flooring only and shall not be installed directly on carpeting, tile or other combustible material.

Check the rating plate and power supply to be sure that the electrical characteristics match. All models use nominal 115 VAC, 1 Phase 60Hz power supply.

Furnace shall be installed so the electrical components are protected from water.

TABLE 1: Unit Clearances to Combustibles

Application	Top	Front	Rear	Left Side	Right Side	Flue	Floor/Bottom	Closet	Alcove	Attic	Line Contact
	In. (cm)	In. (cm)	In. (cm)	In. (cm)	In. (cm)	In. (cm)	In. (cm)				
Downflow	1 (2.5)	3 (7.6)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.5)[1]	Yes	Yes	Yes	NA
Horizontal	0 (0)	3 (7.6)	0 (0)	1 (2.5)	1 (2.5)	0 (0)	0 (0)	Yes	Yes	Yes	Yes[2]

1. Combustible floor base or air conditioning coil required for use on combustible floor.
2. Line contact only permitted between lines formed by the intersection of the rear panel and side panel (top in horizontal position) of the furnace jacket and building joists, studs or framing.

SECTION III: DUCTWORK

DUCTWORK GENERAL INFORMATION

The duct system's design and installation must:

1. Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
2. Be installed in accordance with standards of NFPA (National Fire Protection Association) as outlined in NFPA pamphlets 90A and 90B (latest editions) or applicable national, provincial, or state, and local fire and safety codes.
3. Create a closed duct system. For residential and Non-HUD Modular Home installations, when a furnace is installed so that the supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
4. Complete a path for heated or cooled air to circulate through the air conditioning and heating equipment and to and from the conditioned space.

⚠ CAUTION

The cooling coil must be installed in the supply air duct, downstream of the furnace. Cooled air may not be passed over the heat exchanger.

When the furnace is used in conjunction with a cooling coil, the coil must be installed parallel with, or in the supply air side of the furnace to avoid condensation in the primary heat exchanger. When a parallel flow arrangement is used, dampers or other means used to control airflow must be adequate to prevent chilled air from entering the furnace. If manually operated, the damper must be equipped with means to prevent the furnace or the air conditioner from operating unless the damper is in full heat or cool position.

⚠WARNING

The duct system must be properly sized to obtain the correct airflow for the furnace size that is being installed.

Refer to Table 5 and the furnace rating plate for the correct rise range and static pressures

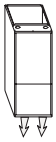
If the ducts are undersized, the result will be high duct static pressures and/or high temperature rises which can result in a heat exchanger OVERHEATING CONDITION. This condition can result in premature heat exchanger failure, which can result in personal injury, property damage, or death.

Installation in a residential garage:

A gas-fired furnace for installation in a residential garage must be installed so the burner(s) and the ignition source are located not less than 18 inches (46 cm) above the floor, and the furnace must be located or protected to avoid physical damage by vehicles.

FLOOR BASE AND DUCTWORK INSTALLATION

Downflow Combustible Floor Base



Installations on combustible materials require the use a combustible floor base shown in Figure 1.

The floor base must be secured to the floor. A supply air duct plenum with 1" (2.54 cm) flange is installed through the opening provided. The supply air duct is then secured to the duct system with screws and sealed to prevent leaks. Do not shoot screws through the flanges of the supply air duct into the top of the combustible floor base. Install the furnace on the combustible floor base so that the corners of the furnace are parallel with the corner brackets of the floor base. Follow the instructions supplied with the combustible floor base accessory.

This combustible floor base can be replaced with a matching cooling coil, properly sealed to prevent leaks. Follow the instructions supplied with the cooling coil cabinet for installing the cabinet to the duct connector. Refer to the installation instructions for additional information.

When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace.

Ductwork Installation

NOTE: When attaching duct flange, do not shoot the screw down into the casing. Use the formed flange intended for duct flange attachment.

A proper Heat Loss/Gain Calculation should be done on all installations for proper application of equipment. From this the ductwork sizing can be calculated, ACCA Manual J and D and industry standards are helpful.

The duct system is a very important part of the installation. **If the duct system is improperly sized the furnace will not operate properly.** The ducts attached to the furnace plenum, should be of sufficient size so that the furnace plenum should be if sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Table 2 is a guide for determining whether the rectangular duct system that the furnace is being connected is of sufficient size for proper furnace operation.

Use the Example below to help you in calculating the duct area to determine whether the ducts have sufficient area so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

The following are general duct sizing guidelines that may not serve to requirements of every application.

Example: The furnace input is 80,000 BTUH, 1,200 CFM blower requirement. The recommended duct area is 216 sq.in, there are two 8 x 12 rectangular ducts attached to the plenum and there are two 7 inch round ducts attached to the furnace.

1. Take 8 x 12, which equals 96 square inch x 2 = 192 square inches then go to round duct size located in Table 3.
2. The square inch area for 7 inch round ducts, 38.4 square inch x 2 = 76.8 square inches,
3. Then take the 192 square inch from the rectangular duct and add it to the 76.8 square inch of round duct. The total square inch of duct attached to the furnace supply plenum is 268.8 square inches. This exceeds the recommended 216 square inch of duct.

In this example, the duct system attached to the plenum has a sufficient area so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate. Providing the return duct is properly sized as well.

TABLE 2: Minimum Duct Sizing For Proper Airflow

Input	Airflow	Return[1]	Rectangular[2]	Round[2]	Supply[3]	Rectangular[2]	Round[2]
BTU/H (kW)	CFM (m^3/min)	In² (cm^2)	in. x in. (cm x cm)	in. (cm) dia.	In² (cm^2)	in. x in. (cm x cm)	in. (cm) dia.
60,000 (17.6)	1,200 (34.0)	280 (1806)	14 x 20 (35.6 x 50.8)	18 (45.7)	216 (1393)	12 x 18 (30.5 x 45.7)	16 (40.6)
80,000 (23.4)	1,200 (34.0)	280 (1806)	14 x 20 (35.6 x 50.8)	18 (45.7)	216 (1393)	12 x 18 (30.5 x 45.7)	16 (40.6)
80,000 (23.4)	1,600 (45.3)	360 (2322)	18 x 20 (45.7 x 50.8)	22 (55.8)	280 (1806)	14 x 20 (35.6 x 50.8)	18 (45.7)
100,000 (29.3)	1,600 (45.3)	360 (2322)	18 x 20 (45.7 x 50.8)	22 (55.8)	280 (1806)	14 x 20 (35.6 x 50.8)	18 (45.7)
100,000 (29.3)	2,000 (56.6)	440 (2838)	20 x 22 (50.8 x 55.8)	24 (60.9)	390 (2516)	16 x 22 (40.6 x 55.8)	22 (55.8)
120,000 (35.2)	2,000 (56.6)	440 (2838)	20 x 22 (50.8 x 55.8)	24 (60.9)	390 (2516)	16 x 22 (40.6 x 55.8)	22 (55.8)
NOTE: This chart does not replace proper duct sizing calculations or take into account static pressure drop for run length and fittings. Watch out for the temperature rise and static pressures.							

1. Maximum return air velocity in rigid duct @ 700 feet per minute (213 m/min).
2. Example return main trunk duct minimum dimensions.
3. Maximum supply air velocity in rigid duct @ 900 feet per minute (274 m/min).

TABLE 3: Round Duct Size

Round Duct Size	Calculated Area For Each Round Duct Size
inches (cm)	Sq.in (cm^2)
5 (13)	19.6 (126)
6 (15)	28.2 (182)
7 (18)	38.4 (248)
8 (20)	50.2 (324)
9 (23)	63.6 (410)
10 (25)	78.5 (506)
11 (28)	95 (613)
12 (30)	113.1 (730)
13 (33)	132.7 (856)
14 (36)	153.9 (993)

1. The Air Temperature Rise is determined by subtracting the Return Air Temperature Reading from the Supply Air Temperature Reading.
2. The External Static Pressure is determined by adding the Supply Duct Static Pressure reading to the Return Duct Static Pressure reading.

TABLES 2 and 3 are to be used as a guide only to help the installer determine if the duct sizes are large enough to obtain the proper air flow (CFM) through the furnace. TABLES 2 and 3 ARE NOT to be used to design ductwork for the building where the furnace is being installed. There are several variables associated with proper duct sizing that are not included in the tables. To properly design the ductwork for the building, Refer to the ASHRAE Fundamentals Handbook, Chapter on "DUCT DESIGN" or a company that specializes in Residential and Modular Home duct designs.

IMPORTANT: If the supply air duct is being connected to the furnace without the use of an accessory duct connector, then a transition duct must be installed with flanges or tabs that are securely attach and sealed to the supply air duct and to the base of the furnace. The transition duct must have insulation between the transition duct and any combustible material.

The transition duct must be the same dimensional size as the rectangular opening in the base of the furnace.

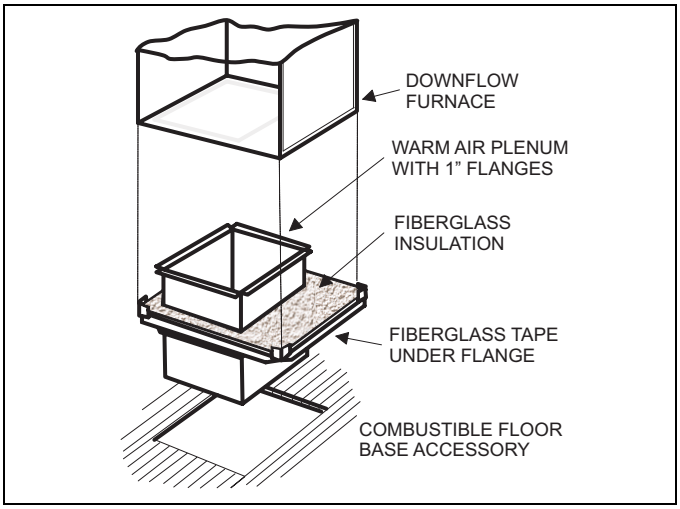


FIGURE 1: Combustible Floor Base Accessory

⚠WARNING

*The supply air temperature **MUST NEVER** exceed the **Maximum Supply Air Temperature**, specified on the nameplate.*

Operating the furnace above the maximum supply air temperature will cause the heat exchanger to overheat, causing premature heat exchanger failure. Improper duct sizing, dirty air filters, incorrect manifold pressure, incorrect gas orifice and/or a faulty limit switch can cause the furnace to operate above the maximum supply air temperature. Refer to Sections III, IV, and X for additional information on correcting the problem.

Downflow Air Conditioning Coil Cabinet

The Cooling Coil Cabinet can be used in place of the combustible floor base for downflow installations on combustible materials. The furnace should be installed with the cooling coil cabinet specifically intended for downflow applications. The cooling coil cabinet must be secured to the floor. A supply air duct plenum is installed through the opening provided. The supply air duct is then secured to the duct system with screws and sealed to prevent leaks. If a matching cooling coil is used, it may be placed directly on the furnace outlet using the accessory transition kit and sealed to prevent leakage. The transition kit must be used to secure the cooling coil cabinet to the furnace casing when installed in a downflow configuration.

This transition kit may be installed in one of two ways. The transition kit may be installed and secured to either the furnace or the cooling coil cabinet by the use of screws and then it must be sealed to prevent leaks.

- If the transition kit has been installed on the cooling coil cabinet it must be secured to the cooling coil cabinet with screws. The supply air side of the furnace is then placed on the cooling coil cabinet and then sealed for leaks.
- If the transition kit has been installed on the supply air side of the furnace it must be secured to the furnace with screws. The furnace and the transition kit are then placed on the cooling coil cabinet and then sealed for leaks.

NOTE: Refer to instructions packed out with coil cabinet, for securing and sealing to the furnace.

IMPORTANT: The furnace, transition kit, and the cooling coil cabinet MUST BE SEALED as needed to prevent leaks, AND SECURED. Refer to the assembly drawing in Figure 2.

IMPORTANT: On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

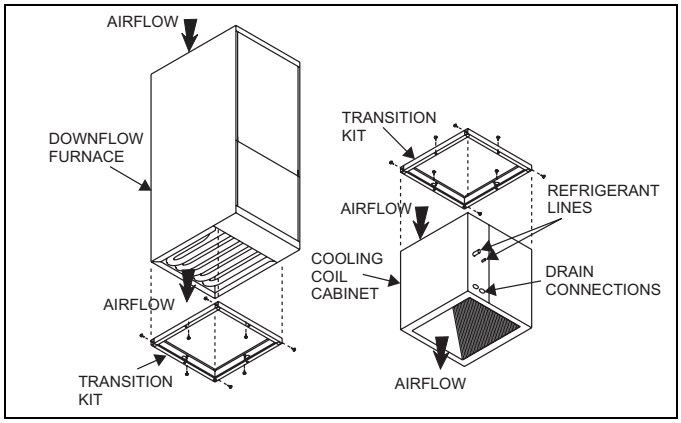
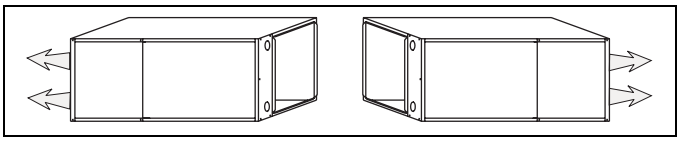


FIGURE 2: Transition Kit Assembly

Horizontal Models



IMPORTANT: This furnace may be installed in a horizontal position on either side as shown above. **It must not be installed on its back.**

Horizontal Installations With a Cooling Coil Cabinet

The furnace should be installed with the cooling coil cabinet specifically intended for horizontal applications. If a matching cooling coil is used, it may be placed directly on the supply air side of the furnace and sealed to prevent leakage. A warm air duct plenum with 1" (2.54 cm) is installed through the opening provided. The supply air duct system is connected to the warm air plenum and sealed to prevent leaks.

IMPORTANT: The furnace, the cooling coil cabinet, and all duct work MUST BE SEALED as needed to prevent leaks, AND SECURED. Refer to the assembly drawing in Figure 2.

Attach the supply plenum to the air conditioning coil cabinet outlet duct flanges through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. The connection to the furnace, air conditioning coil cabinet and the supply plenum should be sealed to prevent air leakage.

The sheet metal plenum should be cross-hatched to eliminate any popping of the sheet metal when the indoor fan is energized. The minimum plenum height is 12" (30.5 cm). If the plenum is shorter than 12" (30.5 cm) the turbulent air flow may cause the limit controls not to operate as designed, or the limit controls may not operate at all. Also the plastic drain pan in the under the air conditioning coil can overheat and melt Refer to the installation instructions supplied with the air conditioning coil for additional information.

Horizontal Installations Without a Cooling Coil Cabinet

When installing this appliance, the furnace must be installed so as to create a closed duct system, the supply duct system must be connected to the furnace outlet and the supply duct system must terminate outside the space containing the furnace. When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace.

Attach the supply plenum to the furnace outlet duct flanges through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. This connection should be sealed to prevent air leakage. The sheet metal should be cross-hatched to eliminate any popping of the sheet metal when the indoor fan is energized. On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

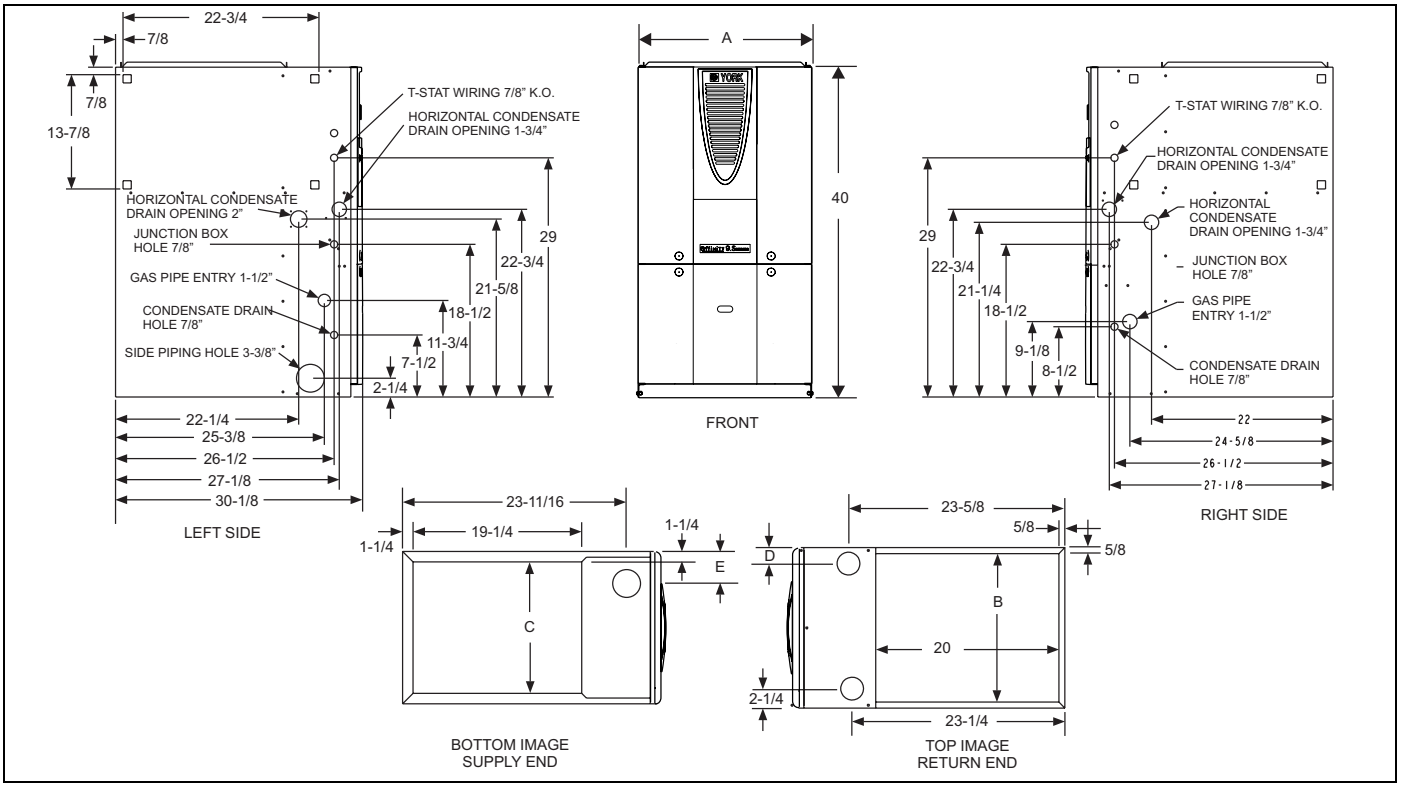


FIGURE 3: Dimensions

BTUH (kW) Input	CFM	Cabinet Size	Cabinet Dimension									
			A (in.)	A (cm)	B (in.)	B (cm)	C (in.)	C (cm)	D (in.)	D (cm)	E (in.)	E (cm)
60 (17.6)	1200 (34.0)	B	17-1/2	44.4	16-1/4	41.3	15	38.1	1-3/4	4.44	2-3/8	6.0
80 (23.4)	1200 (34.0)	B	17-1/2	44.4	16-1/4	41.3	15	38.1	1-3/4	4.44	2-3/8	6.0
80 (23.4)	1600 (45.3)	C	21	53.3	19-3/4	50.2	18-1/2	47.0	2-1/8	5.40	2-3/4	7.0
100 (29.3)	1600 (45.3)	C	21	53.3	19-3/4	50.2	18-1/2	47.0	2-1/8	5.40	2-3/4	7.0
100 (29.3)	2000 (56.6)	C	21	53.3	19-3/4	50.2	18-1/2	47.0	2-1/8	5.40	2-3/4	7.0
120 (35.1)	2000 (56.6)	D	24-1/2	62.2	23-1/4	59.1	22	55.9	2-1/2	6.35	3	7.6

RESIDENTIAL AND NON HUD MODULAR HOME DOWNFLOW AND HORIZONTAL RETURN PLENUM CONNECTION

The return duct system must be connected to the furnace inlet and the return duct system must terminate outside the space containing the furnace. When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace.

Attach the return plenum to the furnace inlet duct flanges. This is typically through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. The connection of the plenum to the furnace and all the ducts connecting to the plenum must be sealed to prevent air leakage. The sheet metal should be cross-hatched to eliminate any popping of the sheet metal when the indoor fan is energized.

The duct system is a very important part of the installation. If the duct system is improperly sized the furnace will not operate properly. The ducts attached to the furnace must be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Attic installations must meet all minimum clearances to combustibles and have floor support with required service accessibility.

IMPORTANT: If an external mounted filter rack is being used see the instructions provided with that accessory for proper hole cut size.

SECTION IV: FILTERS

FILTER INSTALLATION

All applications require the use of a filter. Replacement filter size is shown in Table 4.

TABLE 4: Filter Sizes

CFM (m^3/min)	Cabinet Size	Top Return Filter in (cm)
1200 (34)	B	(2) 14 x 20 (36 x 51)
1600 (45)	C	(2) 14 x 20 (36 x 51)
2000 (57)	C	(2) 14 x 20 (36 x 51)
2000 (57)	D	(2) 14 x 20 (36 x 51)

NOTES:

Air velocity through throwaway type filters may not exceed 300 feet per minute (91.4 m/min). All velocities over this require the use of high velocity filters.

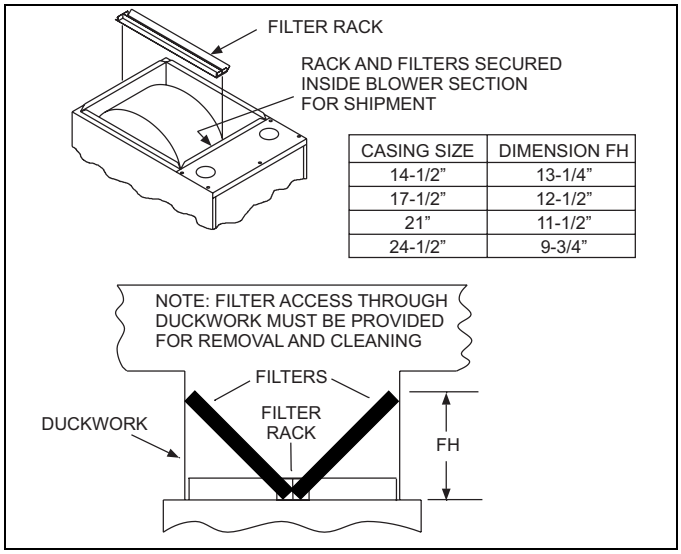


FIGURE 4: Accessory Downflow Filter Rack

Downflow Filters

Downflow furnaces typically are installed with the filters located above the furnace, extending into the return air plenum or duct. Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum above the filter height. Refer to Figure 4 for proper installation.

Filters(s) may be located in the duct system external to the furnace using an external duct filter box attached to the furnace plenum or at the end of the duct in a return filter grille(s). The use of straps and / or supports is required to support the weight of the external filter box. Refer to Figure 5.

If the accessory electronic air cleaner is installed, be sure the air cleaner is designed to accommodate the furnace CFM (cm/m) and the air cleaner is installed so it does not obstruct the return airflow. Consideration should be given when locating the air cleaner for maintenance and temperatures should the indoor fan motor fail to operate. The use of straps and / or supports is required to support the weight of the electronic air cleaner. It is recommended that the air cleaner not be located within 12 inches (30.5 cm) from the top of the return air opening on the furnace. Refer to the instructions supplied with the electronic air cleaner.

⚠ CAUTION

All loose accessories shipped with the furnace must be removed from the blower compartment, prior to installation.

If pleated media air filters or any filter that has a large pressure drop is installed in the return air duct system be sure that the pressure drop caused by the air filter will not prevent the furnace from operating within the rise range specified on the rating plate. If the furnace does not operate within the specified rise range then a larger air filter or an air filter that has a lower pressure drop must be installed.

IMPORTANT: For easier filter access in a downflow configuration, a removable access panel is recommended in the vertical run of the return air plenum immediately above the furnace.

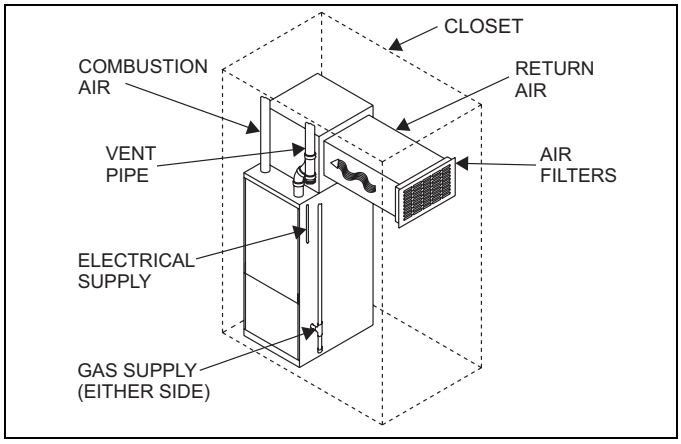


FIGURE 5: Return Filter Grill and Return Duct Installation

Accessory External Filter Installation

1. Install the return filter rack on the top of the furnace return air opening. Secure the filter rack to the front and back flanges with screws. The return air plenum can be placed over the filter rack and the branch ducts (rectangular ducts and / or round ducts) can be attached to the plenum. Route the combustion air and the vent PVC pipes around the access panels for the filters.
2. Install the filter(s) provided or you may install Permanent washable filters. Filter should extend through the entire length of the filter rack to prevent air from bypassing the filter. Make sure that any air filter that is installed in the furnace does not cause an excessive amount of pressure drop. Refer to Table 18: "Filter Performance - Pressure Drop Inches W.C. and (kPa)" for air filter performance and pressure drops.

IMPORTANT: Air velocity through throwaway type filters must not exceed 300 feet per minute (1.52 m/m). All velocities over this require the use of high velocity filters. Refer to Table 18: "Filter Performance - Pressure Drop Inches W.C. and (kPa)".

⚠ CAUTION

All installations must have a filter installed.

HORIZONTAL APPLICATION

Horizontal Filters

All filters and mounting provision must be field supplied. Filters(s) may be located in the duct system external to the furnace or in a return filter grille(s). Filters(s) may be located in the duct system using an external duct filter box attached to the furnace plenum. Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum above the filter height. The use of straps and / or supports is required to support the weight of the external filter box.

ATTIC INSTALLATION

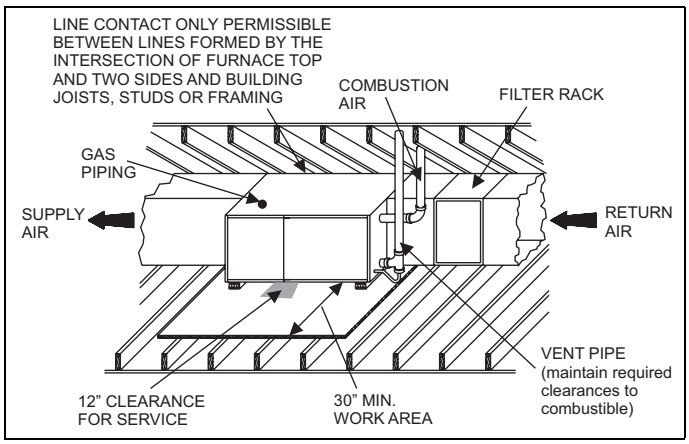

LINE CONTACT ONLY PERMISSIBLE BETWEEN LINES FORMED BY THE INTERSECTION OF FURNACE TOP AND TWO SIDES AND BUILDING JOISTS, STUDS OR FRAMING
COMBUSTION AIR
FILTER RACK
GAS PIPING
SUPPLY AIR
RETURN AIR
VENT PIPE (maintain required clearances to combustible)
12" CLEARANCE FOR SERVICE
30" MIN. WORK AREA

FIGURE 6: Typical Attic Installation

This appliance is design certified for line contact when the furnace is installed in the horizontal left or right position. The line contact is only permissible between lines are formed by the intersection of the top and two sides of the furnace and the building joists, studs or framing. This line may be in contact with combustible material.

IMPORTANT: In either a horizontal left or right installation, a minimum of 8" (20.3 cm) clearance is required beneath the furnace to allow for the installation of the condensate trap and drain pipe. Refer to "CONDENSATE PIPING" section of this manual for more information.

⚠WARNING

When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12 inches (30.5 cm) away from furnace and burner combustion air openings.

⚠ CAUTION

If this furnace is installed over a finished space, a condensate safety pan must be installed.

SUSPENDED FURNACE / CRAWL SPACE INSTALLATION

The furnace can be hung from floor hoists or installed on suitable blocks or pad. Blocks or pad installations shall provide adequate height to ensure the unit will not be subject to water damage. Units may also be suspended from rafters or floor joists using rods, pipe angle supports or straps. Angle supports should be placed at the supply air end and near the blower deck. Do not support at return air end of unit. All four suspension points must be level to ensure quite furnace operation. When suspending the furnace use a secure a platform constructed of plywood or other building material secured to the floor joists. Refer to Figure 7 for typical crawl space installation.

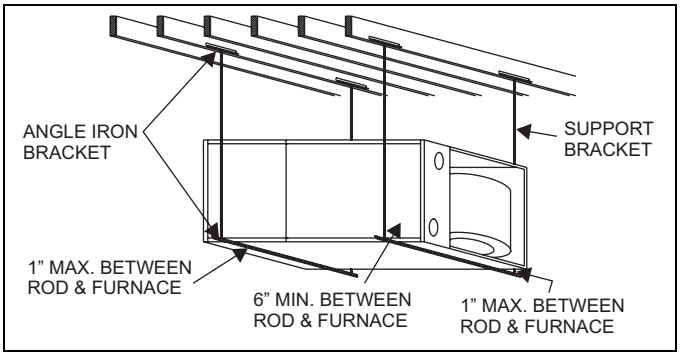


FIGURE 7: Typical Suspended Furnace / Crawl Space Installation

⚠ CAUTION

In any application where temperatures below freezing are possible, see "BELOW FREEZING LOCATIONS".

SECTION V: GAS PIPING

GAS SAFETY

⚠DANGER

An overpressure protection device, such as a pressure regulator, must be installed in the gas piping system upstream of the furnace and must act to limit the downstream pressure to the gas valve so it does not exceed 0.5 PSI {14" w.c. (3.48 kPa)}. Pressures exceeding 0.5 PSI {14" w.c. (3.48 kPa)} at the gas valve will cause damage to the gas valve, resulting in a fire or explosion or cause damage to the furnace or some of its components that will result in property damage and loss of life.

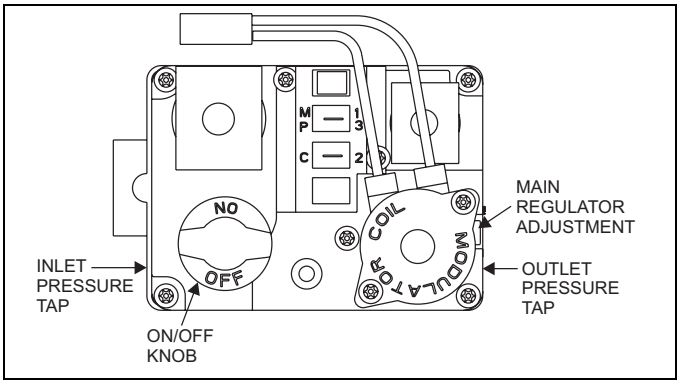


FIGURE 8: Gas Valve

IMPORTANT: Plan your gas supply before determining the correct gas pipe entry. Use 90-degree service elbow(s), or short nipples and conventional 90-degree elbow(s) to enter through the cabinet access holes.

GAS PIPING INSTALLATION

Properly sized wrought iron, approved flexible or steel pipe must be used when making gas connections to the unit. If local codes allow the use of a flexible gas appliance connection, always use a new listed connector. Do not use a connector that has previously serviced another gas appliance.

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. The furnace rating plate and the instructions in this section specify the type of gas approved for this furnace - only use those approved gases. The installation of a drip leg and ground union is required. Refer to Figure 9 and 10.

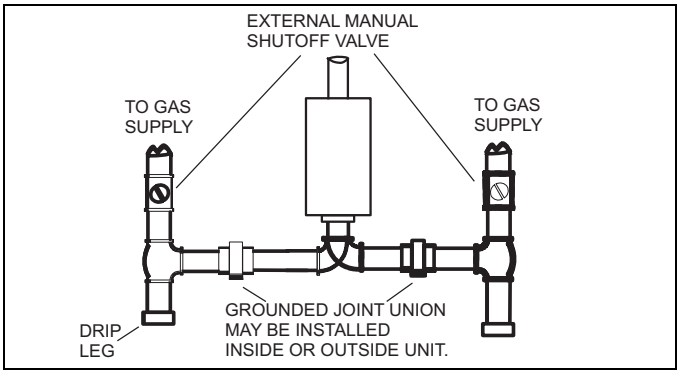

EXTERNAL MANUAL SHUTOFF VALVE
TO GAS SUPPLY
TO GAS SUPPLY
DRIP LEG
GROUNDED JOINT UNION MAY BE INSTALLED INSIDE OR OUTSIDE UNIT.

FIGURE 9: Downflow Gas Piping

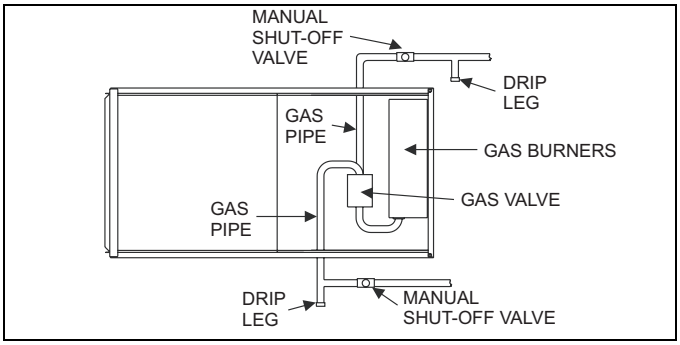


FIGURE 10: Horizontal Gas Piping

IMPORTANT: An accessible manual shut-off valve must be installed upstream of the furnace gas controls and within 6 feet (1.8 m) of the furnace.

The furnace must be isolated from the gas supply piping system by closing its individual external manual shut-off valve during any pressure testing of the gas supply piping system at pressures equal to or greater than 1/2 psig (3.5 kPa).

⚠ CAUTION

The gas valve body is a very thin casting that can take any limited external force. Never apply a pipe wrench to the body of the gas valve when installing piping. A wrench must be placed on the octagonal hub located on the gas inlet side of the valve. Placing a wrench to the body of the gas valve will damage the valve causing improper operation and/or the valve to leak.

Gas piping may be connected from either side of the furnace using any of the gas pipe entry knockouts on both sides of the furnace. Refer to Figure 3.

GAS ORIFICE CONVERSION FOR PROPANE (LP)

This furnace is constructed at the factory for natural gas-fired operation, but may be converted to operate on propane (LP) gas by using a factory-supplied LP conversion kit which includes a new gas valve. Follow the instructions supplied with the LP kit. The instructions in the propane (LP) conversion kit for the proper gas orifice size.

HIGH ALTITUDE OPERATION

This furnace is constructed at the factory for natural gas-fired operation at 0 – 4,000 ft. (0 m – 1220 m) above sea level.

At elevations above 4,000 feet, the furnace will automatically reduce it's input rate if necessary to maintain good combustion. If the natural gas being supplied has also been derated by the gas supplier, it may be necessary to increase the orifice size in order to achieve the rated input.

⚠ DANGER

PROPANE CONVERSION KITS

It is very important to choose the correct kit and/or gas orifices for the altitude and the type of gas for which the furnace is being installed.

Only use natural gas in furnaces designed for natural gas. Only use propane (LP) gas for furnaces that have been properly converted to use propane (LP) gas. Do not use this furnace with butane gas.

Incorrect gas orifices or a furnace that has been improperly converted will create an extremely dangerous condition resulting in premature heat exchanger failure, excessive sooting, high levels of carbon monoxide, personal injury, property damage, a fire hazard and/or death.

Propane (LP) conversions are required in order for the appliance to satisfactory meet the application.

An authorized distributor or dealer must make all gas conversions.

The installer must take every precaution to insure that the furnace has been converted to the proper gas orifice size when the furnace is installed. Do not attempt to drill out any orifices to obtain the proper orifice size. Drilling out a gas orifice will cause misalignment of the burner flames, causing premature heat exchanger burnout, high levels of carbon monoxide, excessive sooting, a fire hazard, personal injury, property damage and/or death.

SECTION VI: ELECTRICAL POWER

TABLE 5: Electrical and Performance Data

Input Max/Min		Output Max/Min		Nominal Airflow		Cabinet Width		AFUE	Air Temp. Rise Maximum Input		Air Temp. Rise Minimum Input	
MBH	kW	MBH	kW	CFM	m^3/min	In.	cm	%	°F	°C	°F	°C
60 / 21	18 / 6	57 / 20	17 / 6	1200	34.0	17-1/2	44.4	95.0	40 - 70	22 - 39	20 - 50	11 - 28
80 / 28	23 / 8	76 / 26	22 / 8	1200	34.0	17-1/2	44.4	95.0	40 - 70	22 - 39	20 - 50	11 - 28
80 / 28	23 / 8	76 / 26	22 / 8	1600	45.3	21	53.3	95.0	40 - 70	22 - 39	20 - 50	11 - 28
100 / 35	29 / 10	95 / 33	28 / 10	1600	45.3	21	53.3	95.0	40 - 70	22 - 39	20 - 50	11 - 28
100 / 35	29 / 10	95 / 33	28 / 10	2000	56.6	21	53.3	95.0	40 - 70	22 - 39	20 - 50	11 - 28
120 / 42	35 / 12	115 / 39	34 / 11	2000	56.6	24-1/2	62.2	95.0	40 - 70	22 - 39	20 - 50	11 - 28

Max. Outlet Air Temp.		Blower		Blower Size		Total Unit	Max. Over-current Protect	Min. Wire Size (awg) @ 75 ft. One Way	Approximate Operating Weight	Power Supply (Voltage-PH-Hz)
°F	°C	HP	Amps	In.	cm	Amps				
170	76.7	1/2	7.7	11 x 8	27.9 x 20.3	9	20	14	136	115-1-60
170	76.7	1/2	7.7	11 x 8	27.9 x 20.3	9	20	14	143	115-1-60
170	76.7	3/4	9.6	11 x 10	27.9 x 25.4	12	20	14	159	115-1-60
170	76.7	3/4	9.6	11 x 10	27.9 x 25.4	12	20	14	163	115-1-60
170	76.7	1	12.8	11 x 11	27.9 x 27.9	14	20	12	165	115-1-60
170	76.7	1	12.8	11 x 11	27.9 x 27.9	14	20	12	182	115-1-60

Annual Fuel Utilization Efficiency (AFUE) numbers are determined in accordance with DOE Test procedures.
Wire size and over current protection must comply with the National Electrical Code (NFPA-70-latest edition) and all local codes.
The furnace shall be installed so that the electrical components are protected from water.

ELECTRICAL POWER CONNECTIONS

All models use nominal 115 VAC, 1 Phase, 60-Hertz power supply. DO NOT CONNECT THIS APPLIANCE TO A 50 HZ POWER SUPPLY OR A VOLTAGE ABOVE 130 VOLTS.

Field wiring to the unit must be grounded. Electric wires that are field installed shall conform to the temperature limitation of 63°F (35°C) rise when installed in accordance with these instructions. Refer to Table 5 in these instructions for specific furnace electrical data.

⚠ CAUTION

Use copper conductors only.

SUPPLY VOLTAGE CONNECTIONS

IMPORTANT: The power connection leads and wiring box may be relocated to the left side of the furnace. Remove the screws and cut wire tie holding excess wiring. Reposition on the left side of the furnace and fasten using holes provided.

1. Provide a power supply separate from all other circuits. Install overcurrent protection and disconnect switch per local/national electrical codes. The switch should be close to the unit for convenience in servicing. With the disconnect or fused switch in the OFF position, check all wiring against the unit wiring label. Refer to the wiring diagram shown in Figure 42.
2. Remove the screws retaining the junction box cover. Route the power wiring through the opening in the unit into the junction box with a conduit connector or other proper connection. In the junction box there will be three wires, a Black Wire, a White Wire and a Green Wire. Connect the power supply as shown on the unit-wiring label on the inside of the blower compartment door or Figure 11. The black furnace lead must be connected to the L1 (hot) wire from the power supply. The white furnace lead must be connected to neutral. Connect the green furnace lead (equipment ground) to the power supply ground. An alternate wiring method is to use a field provided 2” (5.08 cm) x 4” (10.2 cm) box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel. After making the wiring connections replace the wiring box cover and screws.
3. The furnace's control system requires correct polarity of the power supply and a proper ground connection. If the power supply polarity is reversed, the control board will flash 9 times. The furnace will not operate until the polarity is corrected. Refer to “Furnace Diagnostics” section of the “User’s Information, Maintenance, & Service Manual provided with this furnace.

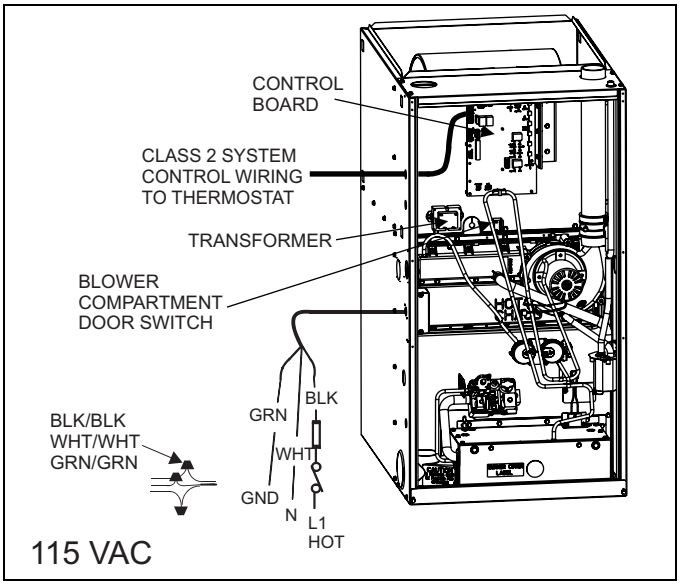


FIGURE 11: Electrical Wiring

LOW VOLTAGE CONTROL WIRING CONNECTIONS

Install the field-supplied thermostat by following the instructions that come with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, connect the thermostat wiring from the wiring connections on the thermostat to the terminal strip on the furnace control board, as shown in Figures 12-16. Electronic thermostats may require the common wire to be connected to the "C" terminal as shown in Figures 12-16. Apply strain relief to thermostat wires passing through cabinet. If air conditioning equipment is installed, use thermostat wiring to connect the Y and C terminals on the furnace control board to the condensing unit (unit outside) as shown in Figures 12-16.

IMPORTANT: Set the heat anticipator in the room thermostat to 0.10 amps. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the set points.

IMPORTANT: Some electronic thermostats do not have adjustable heat anticipators. They should be set to six cycles per hour. Follow the thermostat manufacturer's instructions.

The 24-volt, 40 VA transformer is sized for the furnace components only, and should not be connected to power auxiliary devices such as humidifiers, air cleaners, etc. The transformer may provide power for an air conditioning unit contactor.

For additional connection diagrams for all UPG equipment refer to “Line Voltage System Wiring” document available on-line at www.upgnet.com in the Product Catalog Section.

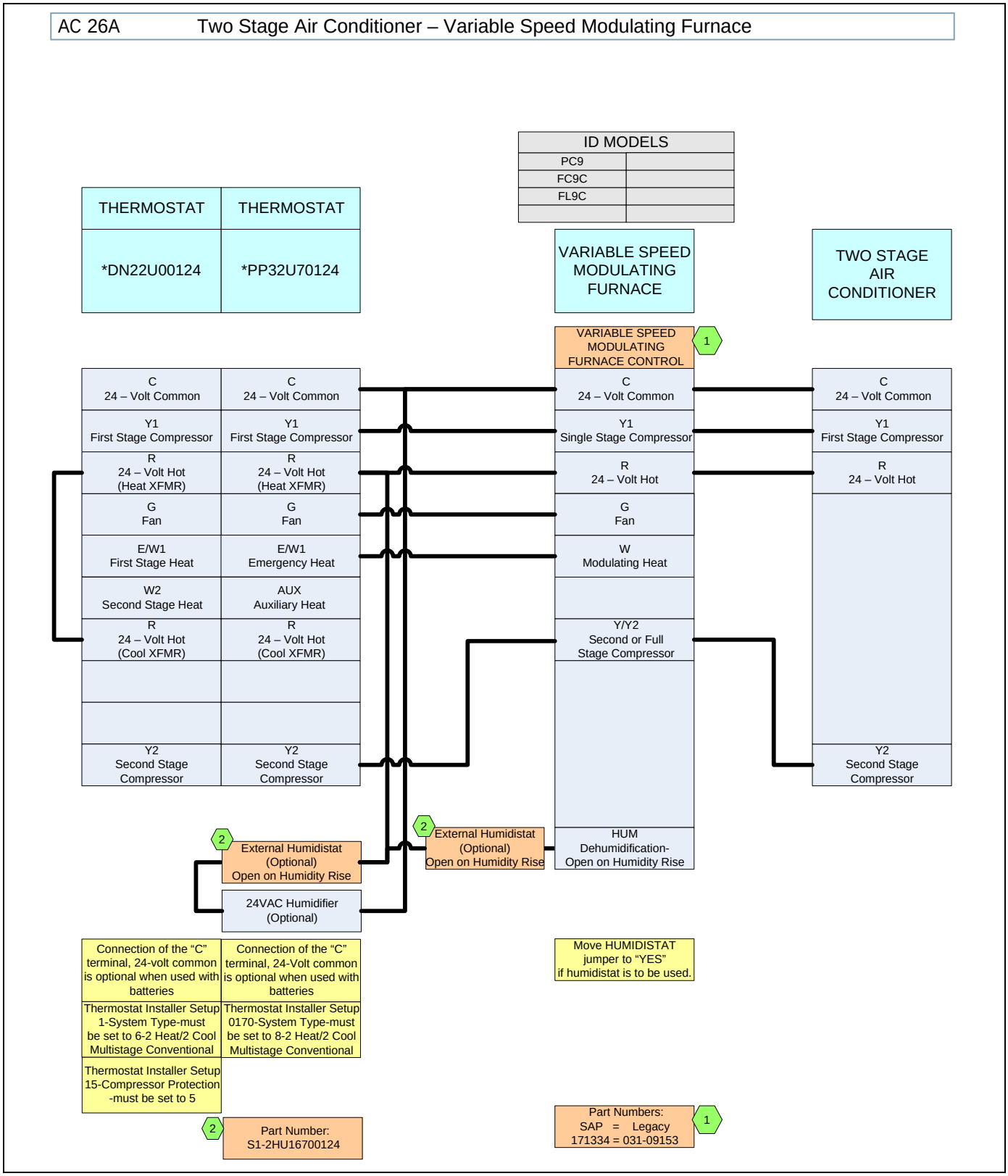

AC 26A
Two Stage Air Conditioner – Variable Speed Modulating Furnace
ID MODELS
PC9
FC9C
FL9C
THERMOSTAT
THERMOSTAT
*DN22U00124
*PP32U70124
VARIABLE SPEED MODULATING FURNACE
TWO STAGE AIR CONDITIONER
VARIABLE SPEED MODULATING FURNACE CONTROL
1
C 24 – Volt Common
C 24 – Volt Common
C 24 – Volt Common
C 24 – Volt Common
Y1 First Stage Compressor
Y1 First Stage Compressor
Y1 Single Stage Compressor
Y1 First Stage Compressor
R 24 – Volt Hot (Heat XFMR)
R 24 – Volt Hot (Heat XFMR)
R 24 – Volt Hot
R 24 – Volt Hot
G Fan
G Fan
G Fan
E/W1 First Stage Heat
E/W1 Emergency Heat
W Modulating Heat
W2 Second Stage Heat
AUX Auxiliary Heat
R 24 – Volt Hot (Cool XFMR)
R 24 – Volt Hot (Cool XFMR)
Y/Y2 Second or Full Stage Compressor
Y2 Second Stage Compressor
Y2 Second Stage Compressor
Y2 Second Stage Compressor
2
External Humidistat (Optional) Open on Humidity Rise
2
External Humidistat (Optional) Open on Humidity Rise
HUM Dehumidification- Open on Humidity Rise
24VAC Humidifier (Optional)
Connection of the “C” terminal, 24-volt common is optional when used with batteries
Connection of the “C” terminal, 24-Volt common is optional when used with batteries
Move HUMIDISTAT jumper to “YES” if humidistat is to be used.
Thermostat Installer Setup 1-System Type-must be set to 6-2 Heat/2 Cool Multistage Conventional
Thermostat Installer Setup 0170-System Type-must be set to 8-2 Heat/2 Cool Multistage Conventional
Thermostat Installer Setup 15-Compressor Protection -must be set to 5
2
Part Number: S1-2HU16700124
Part Numbers: SAP = Legacy 171334 = 031-09153
1

FIGURE 12: Thermostat Chart – Two Stage AC - Variable Speed Modulating Furnace

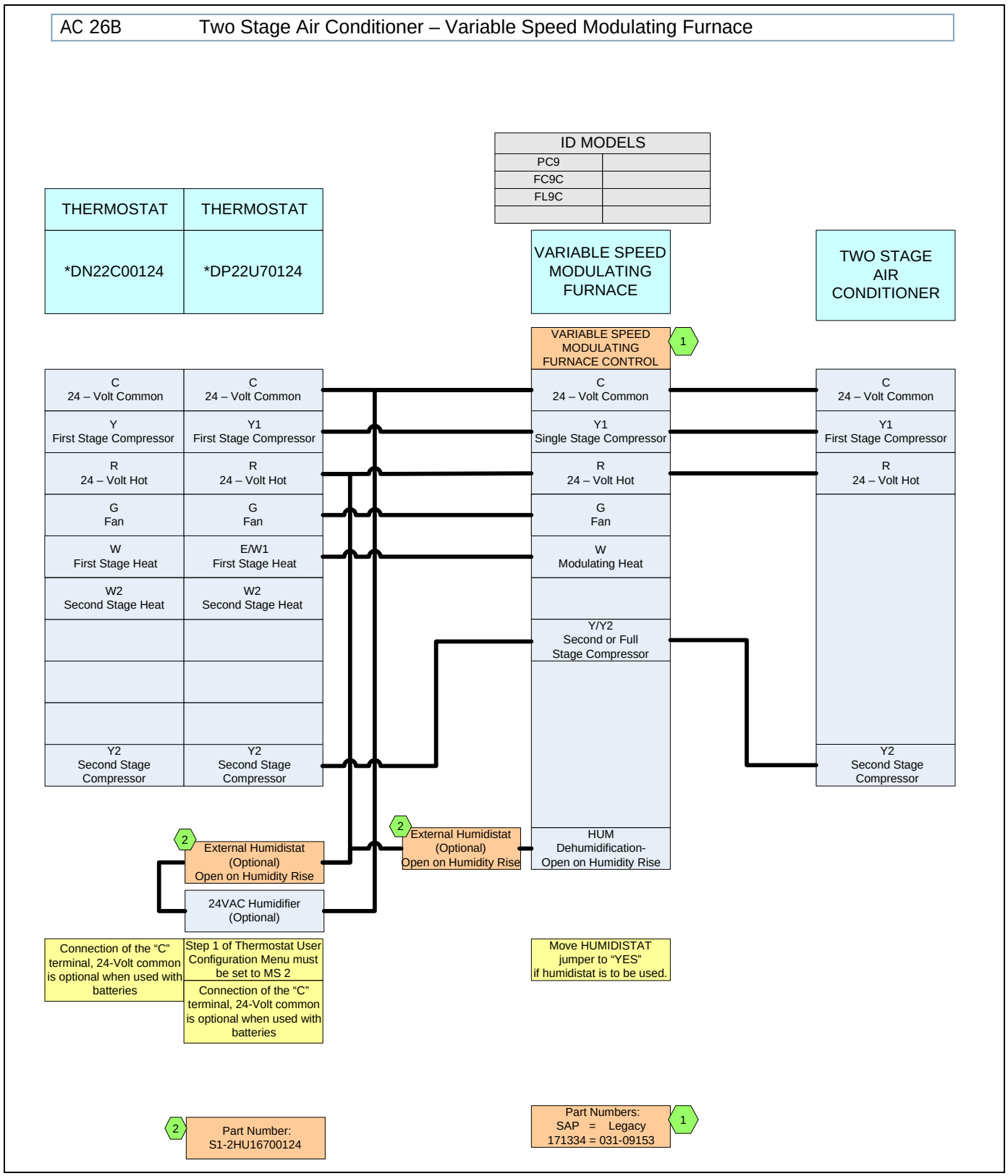

AC 26B Two Stage Air Conditioner – Variable Speed Modulating Furnace
ID MODELS
PC9
FC9C
FL9C
THERMOSTAT
THERMOSTAT
*DN22C00124
*DP22U70124
VARIABLE SPEED MODULATING FURNACE
TWO STAGE AIR CONDITIONER
VARIABLE SPEED MODULATING FURNACE CONTROL
1
C 24 – Volt Common
C 24 – Volt Common
C 24 – Volt Common
C 24 – Volt Common
Y First Stage Compressor
Y1 First Stage Compressor
Y1 Single Stage Compressor
Y1 First Stage Compressor
R 24 – Volt Hot
R 24 – Volt Hot
R 24 – Volt Hot
R 24 – Volt Hot
G Fan
G Fan
G Fan
W First Stage Heat
E/W1 First Stage Heat
W Modulating Heat
W2 Second Stage Heat
W2 Second Stage Heat
Y/Y2 Second or Full Stage Compressor
Y2 Second Stage Compressor
Y2 Second Stage Compressor
2
External Humidistat (Optional) Open on Humidity Rise
2
External Humidistat (Optional) Open on Humidity Rise
HUM Dehumidification- Open on Humidity Rise
24VAC Humidifier (Optional)
Connection of the “C” terminal, 24-Volt common is optional when used with batteries
Step 1 of Thermostat User Configuration Menu must be set to MS 2
Connection of the “C” terminal, 24-Volt common is optional when used with batteries
Move HUMIDISTAT jumper to “YES” if humidistat is to be used.
2
Part Number: S1-2HU16700124
Part Numbers: SAP = Legacy 171334 = 031-09153
1

FIGURE 13: Thermostat Chart – Two Stage AC - Variable Speed Modulating Furnace

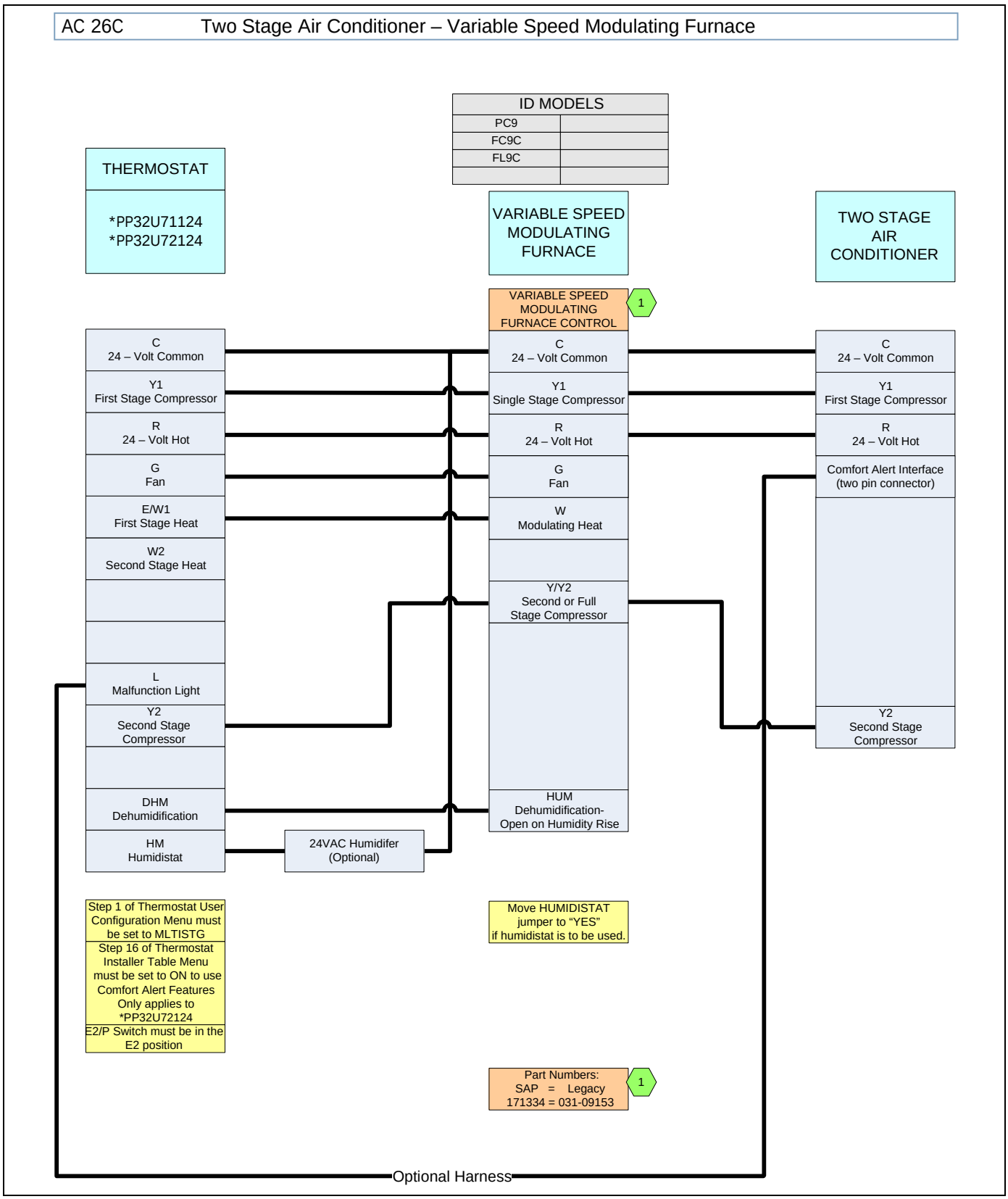

AC 26C Two Stage Air Conditioner – Variable Speed Modulating Furnace
ID MODELS
PC9
FC9C
FL9C
THERMOSTAT
*PP32U71124
*PP32U72124
VARIABLE SPEED MODULATING FURNACE
TWO STAGE AIR CONDITIONER
VARIABLE SPEED MODULATING FURNACE CONTROL
1
C 24 – Volt Common
Y1 First Stage Compressor
R 24 – Volt Hot
G Fan
E/W1 First Stage Heat
W2 Second Stage Heat
L Malfunction Light
Y2 Second Stage Compressor
DHM Dehumidification
HM Humidistat
C 24 – Volt Common
Y1 Single Stage Compressor
R 24 – Volt Hot
G Fan
W Modulating Heat
Y/Y2 Second or Full Stage Compressor
HUM Dehumidification- Open on Humidity Rise
24VAC Humidifer (Optional)
C 24 – Volt Common
Y1 First Stage Compressor
R 24 – Volt Hot
Comfort Alert Interface (two pin connector)
Y2 Second Stage Compressor
Step 1 of Thermostat User Configuration Menu must be set to MLTISTG
Step 16 of Thermostat Installer Table Menu must be set to ON to use Comfort Alert Features Only applies to *PP32U72124
E2/P Switch must be in the E2 position
Move HUMIDISTAT jumper to “YES” if humidistat is to be used.
Part Numbers:
SAP = Legacy
171334 = 031-09153
1
Optional Harness

FIGURE 14: Thermostat Chart – Two Stage AC - Variable Speed Modulating Furnace

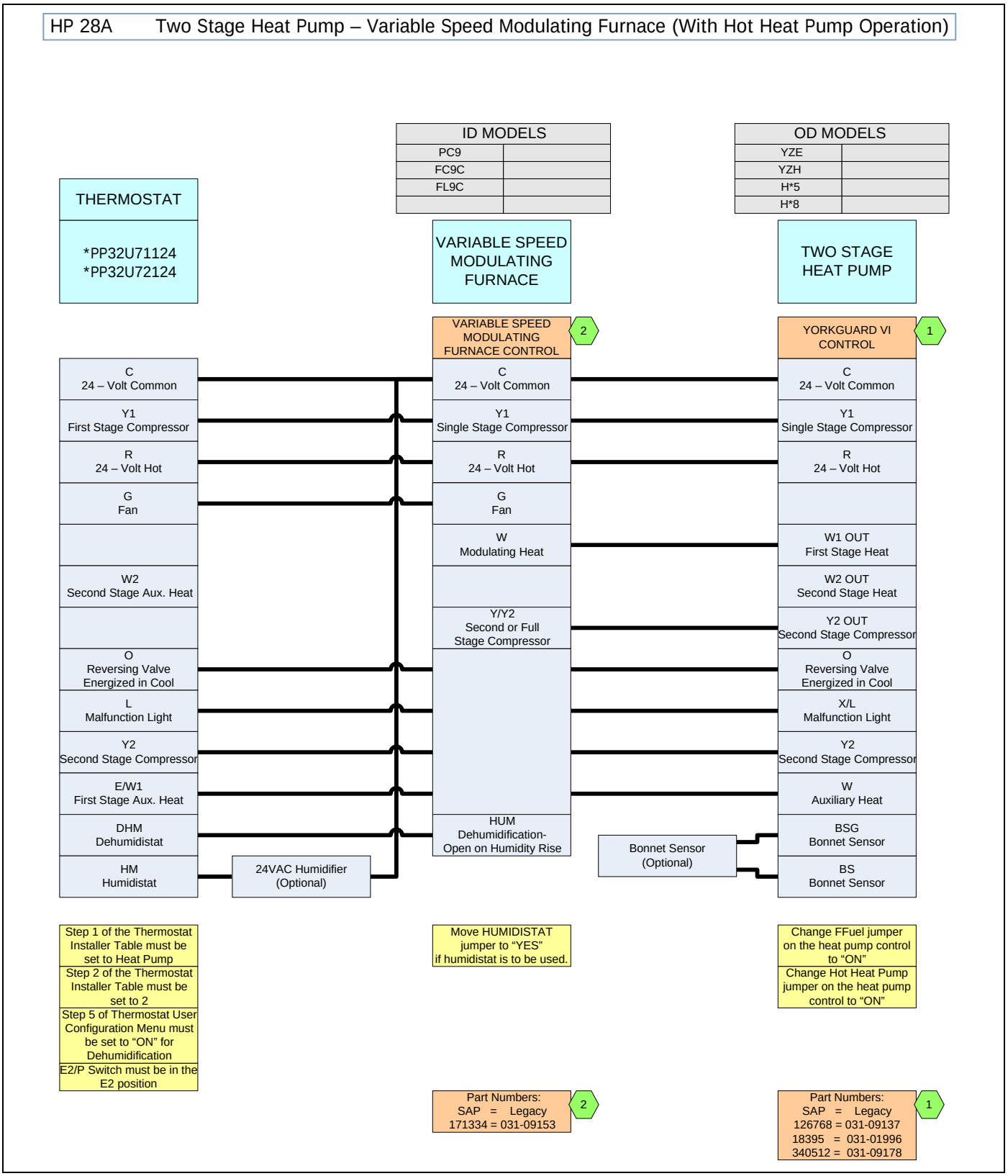

HP 28A Two Stage Heat Pump – Variable Speed Modulating Furnace (With Hot Heat Pump Operation)
ID MODELS
PC9
FC9C
FL9C
OD MODELS
YZE
YZH
H*5
H*8
THERMOSTAT
*PP32U71124
*PP32U72124
VARIABLE SPEED MODULATING FURNACE
TWO STAGE HEAT PUMP
VARIABLE SPEED MODULATING FURNACE CONTROL
2
YORKGUARD VI CONTROL
1
C 24 – Volt Common
Y1 First Stage Compressor
R 24 – Volt Hot
G Fan
W2 Second Stage Aux. Heat
O Reversing Valve Energized in Cool
L Malfunction Light
Y2 Second Stage Compressor
E/W1 First Stage Aux. Heat
DHM Dehumidistat
HM Humidistat
24VAC Humidifier (Optional)
C 24 – Volt Common
Y1 Single Stage Compressor
R 24 – Volt Hot
G Fan
W Modulating Heat
Y/Y2 Second or Full Stage Compressor
HUM Dehumidification- Open on Humidity Rise
C 24 – Volt Common
Y1 Single Stage Compressor
R 24 – Volt Hot
W1 OUT First Stage Heat
W2 OUT Second Stage Heat
Y2 OUT Second Stage Compressor
O Reversing Valve Energized in Cool
X/L Malfunction Light
Y2 Second Stage Compressor
W Auxiliary Heat
BSG Bonnet Sensor
BS Bonnet Sensor
Bonnet Sensor (Optional)
Step 1 of the Thermostat Installer Table must be set to Heat Pump
Step 2 of the Thermostat Installer Table must be set to 2
Step 5 of Thermostat User Configuration Menu must be set to “ON” for Dehumidification
E2/P Switch must be in the E2 position
Move HUMIDISTAT jumper to “YES” if humidistat is to be used.
Change FFuel jumper on the heat pump control to “ON”
Change Hot Heat Pump jumper on the heat pump control to “ON”
Part Numbers: SAP = Legacy 171334 = 031-09153
2
Part Numbers: SAP = Legacy 126768 = 031-09137 18395 = 031-01996 340512 = 031-09178
1

FIGURE 15: Thermostat Chart – Two Stage HP - Variable Speed Modulating Furnace with Hot Heat Pump Operation

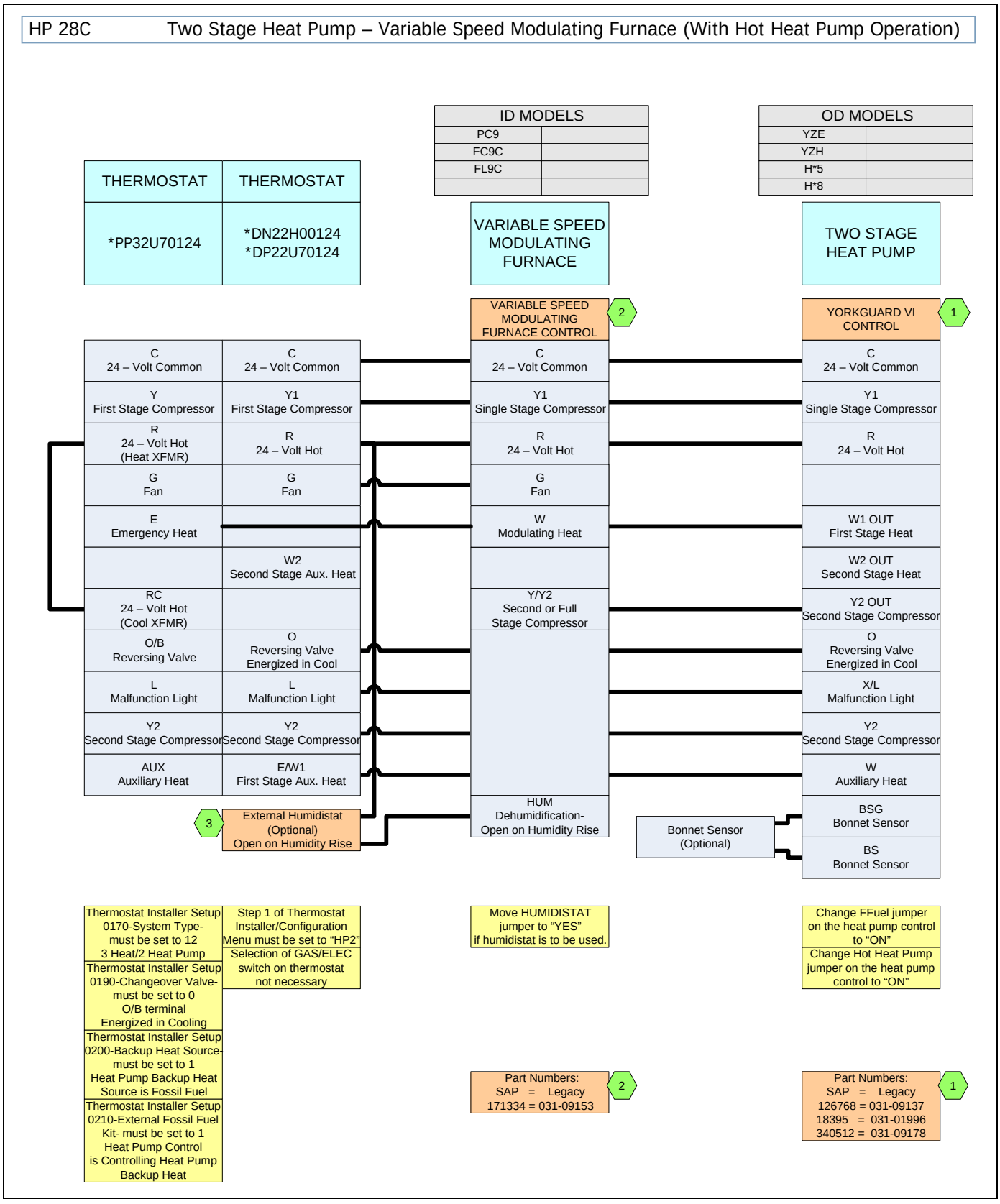

HP 28C Two Stage Heat Pump – Variable Speed Modulating Furnace (With Hot Heat Pump Operation)
ID MODELS
PC9
FC9C
FL9C
OD MODELS
YZE
YZH
H*5
H*8
THERMOSTAT
THERMOSTAT
*PP32U70124
*DN22H00124
*DP22U70124
VARIABLE SPEED MODULATING FURNACE
TWO STAGE HEAT PUMP
VARIABLE SPEED MODULATING FURNACE CONTROL
2
YORKGUARD VI CONTROL
1
C 24 – Volt Common
C 24 – Volt Common
C 24 – Volt Common
C 24 – Volt Common
Y First Stage Compressor
Y1 First Stage Compressor
Y1 Single Stage Compressor
Y1 Single Stage Compressor
R 24 – Volt Hot (Heat XFMR)
R 24 – Volt Hot
R 24 – Volt Hot
R 24 – Volt Hot
G Fan
G Fan
G Fan
E Emergency Heat
W Modulating Heat
W1 OUT First Stage Heat
W2 Second Stage Aux. Heat
W2 OUT Second Stage Heat
RC 24 – Volt Hot (Cool XFMR)
Y/Y2 Second or Full Stage Compressor
Y2 OUT Second Stage Compressor
O/B Reversing Valve
O Reversing Valve Energized in Cool
O Reversing Valve Energized in Cool
L Malfunction Light
L Malfunction Light
X/L Malfunction Light
Y2 Second Stage Compressor
Y2 Second Stage Compressor
Y2 Second Stage Compressor
AUX Auxiliary Heat
E/W1 First Stage Aux. Heat
W Auxiliary Heat
3
External Humidistat (Optional) Open on Humidity Rise
HUM Dehumidification- Open on Humidity Rise
Bonnet Sensor (Optional)
BSG Bonnet Sensor
BS Bonnet Sensor
Thermostat Installer Setup 0170-System Type- must be set to 12 3 Heat/2 Heat Pump
Step 1 of Thermostat Installer/Configuration Menu must be set to “HP2”
Move HUMIDISTAT jumper to “YES” if humidistat is to be used.
Change FFuel jumper on the heat pump control to “ON”
Selection of GAS/ELEC switch on thermostat not necessary
Change Hot Heat Pump jumper on the heat pump control to “ON”
Thermostat Installer Setup 0190-Changeover Valve- must be set to 0 O/B terminal Energized in Cooling
Thermostat Installer Setup 0200-Backup Heat Source- must be set to 1 Heat Pump Backup Heat Source is Fossil Fuel
Thermostat Installer Setup 0210-External Fossil Fuel Kit- must be set to 1 Heat Pump Control is Controlling Heat Pump Backup Heat
Part Numbers: SAP = Legacy 171334 = 031-09153
2
Part Numbers: SAP = Legacy 126768 = 031-09137 18395 = 031-01996 340512 = 031-09178
1

FIGURE 16: Thermostat Chart – Two Stage HP - Variable Speed Modulating Furnace with Hot Heat Pump Operation

ACCESSORY CONNECTIONS

The furnace control will allow power-switching control of various accessories. Refer to Figure 17, for connection details.

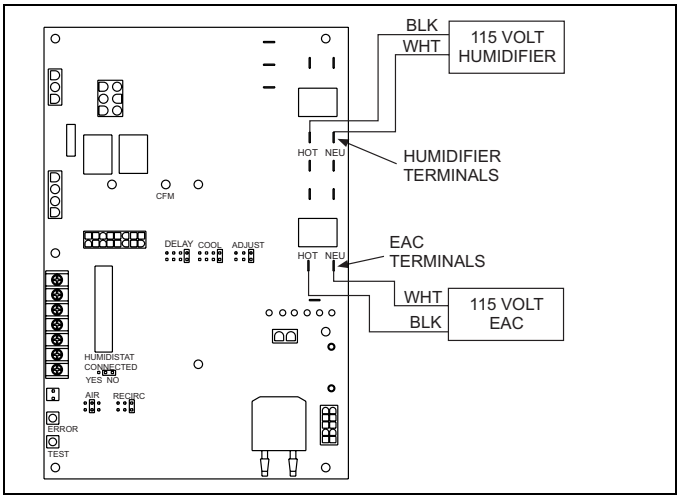


FIGURE 17: Accessory Connections

ELECTRONIC AIR CLEANER CONNECTION

Two 1/4" (0.64 cm) spade terminals (EAC and NEUTRAL) for electronic air cleaner connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during circulating blower operation.

HUMIDIFIER CONNECTION

Two 1/4" (0.64 cm) spade terminals (HUM and NEUTRAL) for humidifier connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during heating system operation.

TWINNING

These furnaces are not to be twinned. If more than one furnace is needed in an application, each furnace must have its own complete duct system and its own wall thermostat.

SECTION VII: COMBUSTION AIR AND VENT SYSTEM

COMBUSTION AIR AND VENT SAFETY

This Category IV, dual certified direct vent furnace is designed for residential application. It may be installed without modification to the condensate system in a basement, garage, equipment room, alcove, attic or any other indoor location provided the space temperature is 32 °F (0°C) or higher and where all required clearance to combustibles and other restrictions are met. The combustion air and the venting system must be installed in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code Z223.1/NFPA 54 (latest edition), or Sections 7.2, 7.3 or 7.4 of CSA B149.1, National Gas and Propane Codes (latest edition) or applicable provisions of the local building code and these instructions.

IMPORTANT: The "VENT SYSTEM" must be installed as specified in these instructions for Residential and Non HUD Modular Homes. The sealed combustion air / vent system is the only configuration that can be installed in a Non HUD Modular Home.

⚠WARNING

This furnace may not be common vented with any other appliance, since it requires separate, properly sized air intake and vent lines. The furnace shall not be connected to any type of B, BW or L vent or vent connector, and not connected to any portion of a factory-built or masonry chimney

The furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.

⚠ CAUTION

When combustion air pipe is installed above a suspended ceiling or when it passes through a warm and humid space, the pipe must be insulated with 1/2" Armaflex or other heat resistant type insulation.

Vent piping must be insulated with 1/2" insulation if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.

COMBUSTION AIR/VENT PIPE SIZING

The size of pipe required will be determined by the furnace model, the total length of pipe required and the number of elbows required.

Table 6 lists the maximum equivalent length of pipe allowed for each model of furnace. The equivalent length of elbows is shown in Table 7. The equivalent length of the vent system is the total length of straight pipe PLUS the equivalent length of all of the elbows.

The following rules must also be followed:

1. Long radius (sweep) elbows are recommended. Standard elbows may be used, but since they have a longer equivalent length, they will reduce the total length of pipe that will be allowed. Short radius (plumbing vent) elbows are not allowed. The standard dimensions of the acceptable elbows are shown below.
2. The maximum equivalent length listed in Table 6 is for the vent piping and the air intake piping separately. For example, if the table allows 65 equivalent feet for a particular model, then the vent can have 65 equivalent feet of pipe, AND the combustion air intake can have another 65 equivalent feet of pipe.
3. Three vent terminal elbows (two for the vent and one for the combustion air intake) are already accounted for and need not be included in the equivalent length calculation.
4. All combustion air and vent pipe must conform to American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), F891 (PVC-DWV Cellular Core), D2261 (ABS-DWV) or F628 (Schedule 40 ABS). Pipe cement and primer must conform to ASTM Standard D2546 (PVC) or D2235 (ABS). If ABS pipe is to be used, any joint where ABS pipe is joined to PVC pipe must be glued with cement that is approved for use with BOTH materials. Metallic materials must not be used for venting or air intake.
5. If a flexible connector is used in the vent system, it must be made of a material that is resistant to acidic exposure and to at least 225° F temperature. Flexible connectors are also allowed in the combustion air pipe.
6. All models are supplied with 2" vent connections. When the pipe must be increased to 3" diameter, the transition from 2" to 3" must be done as close to the furnace as possible. For upflow models, the transition from 2" to 3" should be done immediately above the furnace. For downflow or horizontal models, the transition from 2" to 3" pipe should be done immediately after the drain tee or drain elbow.
7. In Canada, vents shall be certified to ULC S636, Standard for Type BH Gas Venting Systems. IPEX System 636 PVC is certified to this standard.
8. In Canada, the first three feet (900 mm) of the vent must be readily accessible for inspection.

TABLE 6: Maximum Equivalent Pipe Length

Model Input BTUH (kW)	Pipe Size Inches (cm)	Maximum Equivalent length feet (m)
60,000 (17.6)	**2** (5.1)	**65** (19.8)
60,000 (17.6)	**3** (7.6)	**90** (27.4)
80,000 (23.4)	**2** (5.1)	**65** (19.8)
80,000 (23.4)	**3** (7.6)	**90** (27.4)
100,000 (29.3)	**2** (5.1)	**30** (9.2)
100,000 (29.3)	**3** (7.6)	**85** (25.9)
120,000 (29.3)	**3** (7.6)	**60** (18.3)

TABLE 7: Equivalent Length of Fittings

Fitting	Equivalent Length
2" 90º sweep elbow	5 feet of 2" pipe
2" 45º sweep elbow	2-1/2 feet of 2" pipe
2" 90º standard elbow	10 feet of 2" pipe
2" 45º standard elbow	5 feet of 2" pipe
3" 90º sweep elbow	5 feet of 3" pipe
3" 45º sweep elbow	2-1/2 feet of 3" pipe
3" 90º standard elbow	10 feet of 3" pipe
3" 45º standard elbow	5 feet of 3" pipe
2" corrugated connector	10 feet of 2" pipe
3" corrugated connector	10 feet of 3" pipe

Example:

An 80,000 BTUH furnace requires 32 feet of pipe and four 90º elbows. Using 2" pipe and standard elbows, the total equivalent length will be:

32 feet of 2" pipe =	32 equivalent feet
4 - 90º standard 2" elbows = (4x10) =	40 equivalent feet
Total =	72 equivalent feet of 2" pipe

This exceeds the 65 foot maximum equivalent length of 2" pipe allowed for that model and is thus not acceptable.

By using sweep elbows, the total equivalent length will be:

32 feet of 2" pipe =	32 equivalent feet
4 - 90º standard 2" elbows = (4x5) =	20 equivalent feet
Total =	52 equivalent feet of 2" pipe

This is less than the 65 foot maximum equivalent length of 2" pipe allowed for that model and is thus acceptable.

Alternatively, using 3" pipe and standard elbows, the total equivalent length will be:

32 feet of 3" pipe =	32 equivalent feet
4 - 90º standard 2" elbows = (4x5) =	40 equivalent feet
Total =	72 equivalent feet of 3" pipe

This is less than the 90 foot maximum equivalent length of 3" pipe allowed for that model and is thus acceptable.

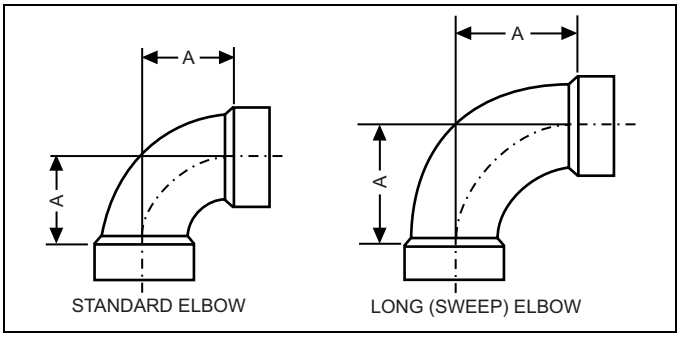


FIGURE 18: Dimensions

TABLE 8: Elbow Dimensions

Elbow	"A" Dimension
2" Standard	2-5/16"
3" Standard	3-1/16"
2" Sweep	3-1/4"
3" Sweep	4-1/16"

Dimensions are those required in Standard ASTM D-3311.

NOTE: Sidewall vent terminal may be used for sidewall vent terminations. Refer to part list in the back of the USERS INFORMATION AND SERVICE AND MAINTENANCE MANUAL for the terminal part number.

TABLE 9: Combustion Air Intake and Vent Connection Size at Furnace (All Models)

FURNACE VENT CONNECTION SIZES		
Furnace Input	60 - 100 MBH (17.5 - 29.3 kW)	120 MBH (35.2 kW)
Intake Pipe Size	2" (5.1 cm)	3" (7.6 cm)
Vent Pipe Size	2" (5.1 cm)	3" (7.6 cm)*

*. Vent pipe size must be increased to 3" diameter after connection to furnace on this model.

IMPORTANT: Accessory concentric vent / intake termination kits 1CT0302 and 1CT0303 are available and approved for use with these furnaces. Horizontal sidewall vent terminations kits 1HT0901 & 1HT0902 are also approved for use with these furnaces.

IMPORTANT: Furnace vent pipe connections are sized for 2" (5.1 cm). pipe. Any pipe size change must be made outside the furnace casing in a vertical pipe section to allow proper drainage of condensate. An offset using two 45º (degree) elbows will be required for plenum clearance when the vent is increased to 3" (7.6 cm).

COMBUSTION AIR AND VENT PIPING ASSEMBLY

The final assembly procedure for the combustion air and vent piping is as follows:

1. Cut piping to the proper length beginning at the furnace.
2. Deburr the piping inside and outside.
3. Chamfer (bevel) the outer edges of the piping.
4. Dry-fit the vent piping assembly from the furnace to the outside termination checking for proper fit support and slope.
5. Dry-fit the combustion air piping assembly checking for proper fit, support and slope on the following systems:
   A. Sealed combustion air systems from the furnace to the outside termination.
   B. Ventilated combustion air systems from the furnace to the attic or crawl space termination.

⚠ CAUTION

Solvent cements are flammable and must be used in well-ventilated areas only. Keep them away from heat, sparks and open flames. Do not breathe vapors and avoid contact with skin and eyes.

6. Disassemble the combustion air and vent piping, apply cement primer and the cement per the manufactures instructions. Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 for ABS piping.
7. All joints must provide a permanent airtight and watertight seal.
8. Support the combustion air and vent piping such that it is angled a minimum of 1/4" per foot (0.635 cm/m) so that condensate will flow back towards the furnace. Piping should be supported with pipe hangers to prevent sagging.
9. Seal around the openings where the combustion air and / or vent piping pass through the roof or sidewalls.

COMBUSTION AIR / VENT CLEARANCES

IMPORTANT: The vent must be installed with the following minimum clearances, and must comply with local codes and requirements.

VENT CLEARANCES

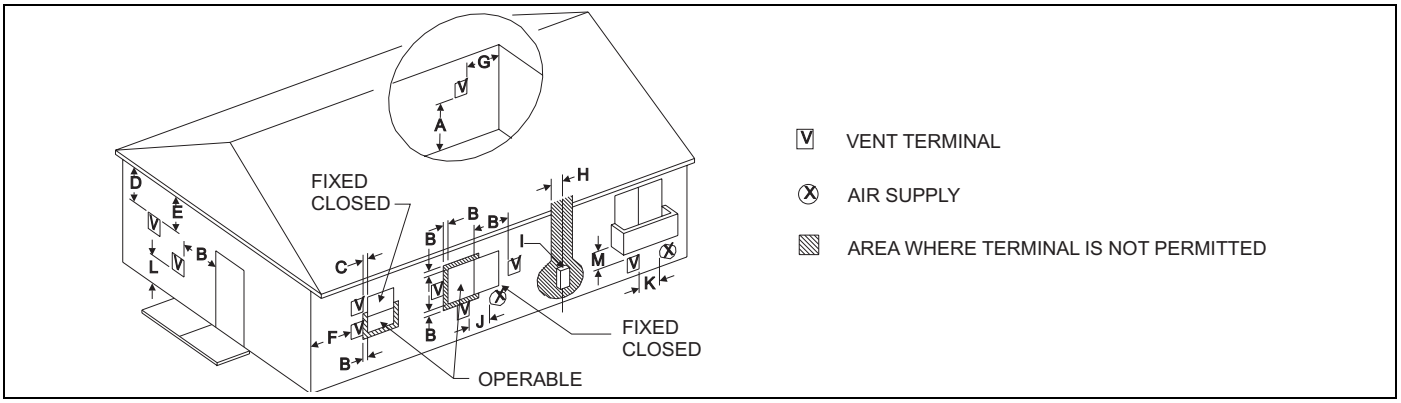


FIGURE 19: Home Layout

Direct Vent Terminal Clearances	Canadian Installations[1,3]	US Installation[2,3]
A. Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm)	12 inches (30 cm)
B. Clearance to window or door that may be opened	12 inches (30 cm) for models ≤100,000 BTUH (30 kW), 36 inches (91 cm) for models >100,000 BTUH (30 kW)	Two-pipe (direct vent) applications: 9 inches (23 cm) for models ≤50,000 BTUH (15 kW), 12 inches (30 cm) for models >50,000 BTUH (15 kW). ††
C. Clearance to permanently closed window	12 inches (30 cm)	12 inches (30 cm)
D. Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier.	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier
E. Clearance to unventilated soffit	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier
F. Clearance to outside corner	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier
G. Clearance to inside corner	3 feet (91 cm)	3 feet (91 cm)
H. Clearance to each side of center line extended above meter/regulator assembly	Above a meter/regulator assembly within 3 feet (91 cm) horizontally of the vertical center-line of the regulator vent outlet to a maximum vertical distance of 15 feet (4.5 cm) above the meter/regulator assembly.	Above a meter/regulator assembly within 3 feet (91 cm) horizontally of the vertical center-line of the regulator vent outlet to a maximum vertical distance of 15 feet (4.5 cm) above the meter/regulator assembly.
I. Clearance to service regulator vent outlet	3 feet (91 cm)	3 feet (91 cm) or in accordance with local installation codes and the requirements of the gas supplier.
J. Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	12 inches (30 cm) for models ≤100,000 BTUH (30 kW), 36 inches (91 cm) for models >100,000 BTUH (30 kW)	Two-pipe (direct vent) applications: 9 inches (23 cm) for models ≤50,000 BTUH (15 kW), 12 inches (30 cm) for models >50,000 BTUH (15 kW).
K. Clearance to a mechanical supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3 cm) horizontally
L. Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m)†	7 feet (2.13 m) or in accordance with local installation codes and the requirements of the gas supplier.
M. Clearance under veranda, porch, deck, or balcony	12 inches (30 cm)‡	12 inches (30 cm) or in accordance with local installation codes and the requirements of the gas supplier.

1. In accordance with the current CSA B149.1-00, Natural Gas and Propane Installation Code.
2. In accordance with the current ANSI Z223.1 / NFPA 54, National Gas Code.
3. In accordance with the current ANSI Z21.47 * CSA 2.3 American National Standard.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

†† 12 inches (30 cm) up from the bottom edge of the structure for Two-pipe (direct vent) applications per ANSI Z223.1 / NFPA 54, National Gas Code.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor and the distance between the top of the vent termination and the underside of the veranda, porch, or deck is greater than 1 foot (30 cm) as specified in CSA B149.1-00.

A vent shall not terminate less than 1 foot (30 cm) above a grade level.

Any fresh air or make up inlet for dryer or furnace area is considered to be forced air inlet.

Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.

A terminus of a vent shall be fitted with a cap in accordance with the vent manufacturer's installation instructions, or in accordance with the installation instructions for a special venting system.

IMPORTANT: Consideration must be given for degradation of building materials by flue gases. Sidewall termination may require sealing or shielding of building surfaces with a corrosion resistant material to protect against combustion product corrosion. Consideration must be given to wind direction in order to prevent flue products and/or condensate from being blown against the building surfaces. If a metal shield is used it must be a stainless steel material at a minimum dimension of 20 inches. It is recommended that a retaining type collar be used that is attached to the building surface to prevent movement of the vent pipe.

Responsibility for the provision of proper adequate venting and air supply for application shall rest with the installer.

Vent shall extend high enough above building, or a neighboring obstruction, so that wind from any direction will not create a positive pressure in the vicinity of the vent.

VENT SYSTEM

This furnace is certified to be installed with one of two possible vent configurations.

1. Horizontal vent system. This vent system can be installed completely horizontal or combinations of horizontal, vertical, or offset using elbows.
2. Vertical vent system. This vent system can be installed completely vertical or a combination of horizontal, vertical, or offset using elbows.

HORIZONTAL VENT APPLICATIONS AND TERMINATION

When selecting the location for a horizontal combustion air / vent termination, the following should be considered:

1. Observe all clearances listed in vent clearances in these instructions.
2. Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
3. Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
4. Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
5. Termination should be positioned where vent vapors are not objectionable.
6. Horizontal portions of the vent system must slope upwards and be supported to prevent sagging. The vent system may be supported by the use of clamps or hangers secured to a permanent part of the structure every 4 ft. (1.22 m).
7. Sealed combustion air systems must be installed so the vent and the combustion air pipes terminate in the same atmospheric zone. Refer to Figures 22-24.

DOWNFLOW VENT ASSEMBLY

1. Place the 2” (5.08 cm) 45° PVC street elbow on the vent connection shown in Figure 20.
2. Place the 2” (5.08 cm) PVC WYE (“Y”) assembly on the 2” (5.08 cm) 45° PVC street elbow as shown in Figure 20.
3. Locate the rubber condensate hose in front of the blower access panel.
4. Slide the hose through the hole in the top cover, and insert the hose on to the barbed fitting on the bottom of the 2” (5.08 cm) PVC WYE (“Y”) assembly as shown in Figure 20.

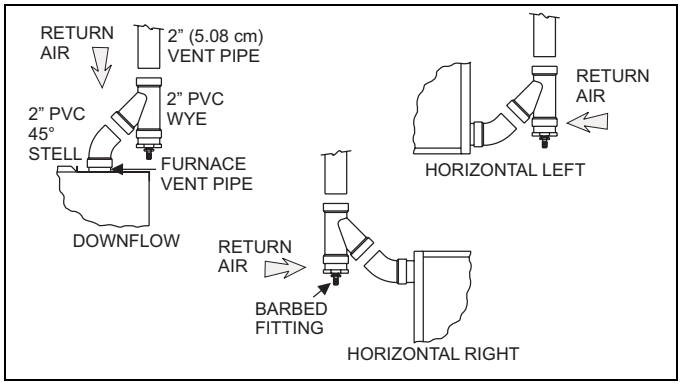


FIGURE 20: Downflow/Horizontal Vent Assembly

HORIZONTAL VENT ASSEMBLY

Horizontal Left Vent Assembly

1. Place the 2” (5.08 cm) 45° PVC street elbow on the vent connection shown in Figure 20.
2. Place the 2” (5.08 cm) PVC WYE (“Y”) assembly on the 2” (5.08 cm) 45° PVC street elbow as shown in Figure 20.
3. Refer to the “DOWNFLOW/HORIZONTAL CONDENSATE INTERNAL DRAIN CONFIGURATIONS” for further details.

Horizontal Right Vent Assembly

1. Place the 2” (5.08 cm) 45° PVC street elbow on the vent connection shown in Figure 20.
2. Place the 2” (5.08 cm) PVC WYE (“Y”) assembly on the 2” (5.08 cm) 45° PVC street elbow as shown in Figure 20.
3. Refer to the “DOWNFLOW/HORIZONTAL CONDENSATE INTERNAL DRAIN CONFIGURATIONS” for further details.

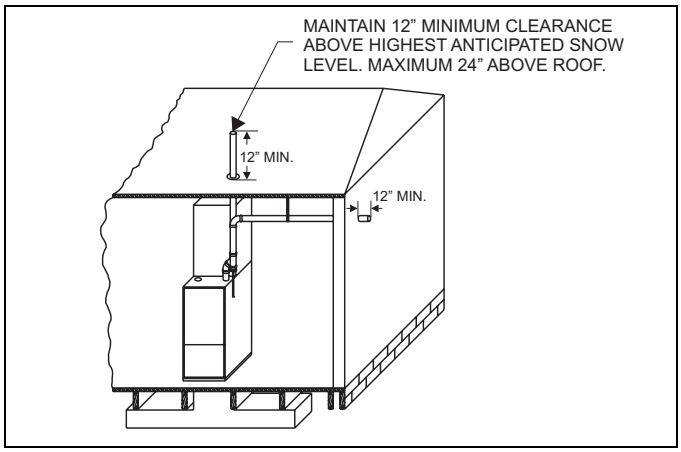


FIGURE 21: Termination Configuration - 1 Pipe

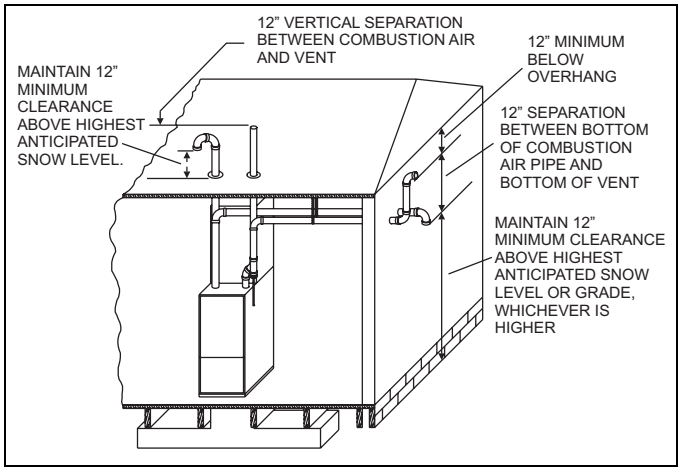

12” VERTICAL SEPARATION BETWEEN COMBUSTION AIR AND VENT
12” MINIMUM BELOW OVERHANG
MAINTAIN 12” MINIMUM CLEARANCE ABOVE HIGHEST ANTICIPATED SNOW LEVEL.
12” SEPARATION BETWEEN BOTTOM OF COMBUSTION AIR PIPE AND BOTTOM OF VENT
MAINTAIN 12” MINIMUM CLEARANCE ABOVE HIGHEST ANTICIPATED SNOW LEVEL OR GRADE, WHICHEVER IS HIGHER

FIGURE 22: Termination Configuration - 2 Pipe

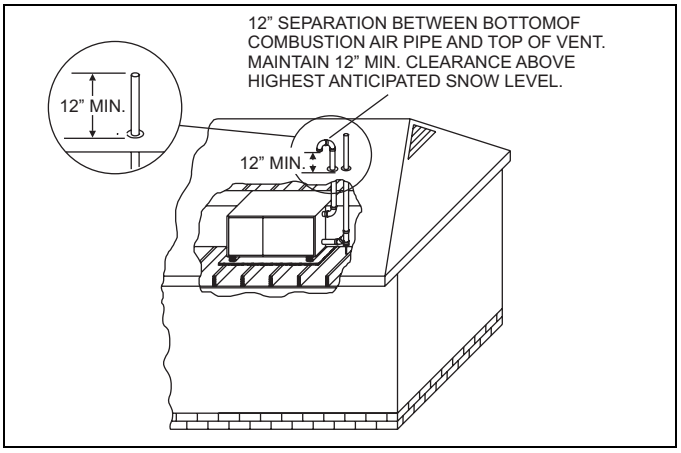

12" SEPARATION BETWEEN BOTTOMOF
COMBUSTION AIR PIPE AND TOP OF VENT.
MAINTAIN 12" MIN. CLEARANCE ABOVE
HIGHEST ANTICIPATED SNOW LEVEL.
12" MIN.
12" MIN.

FIGURE 23: Termination Configuration - 2 Pipe Horizontal

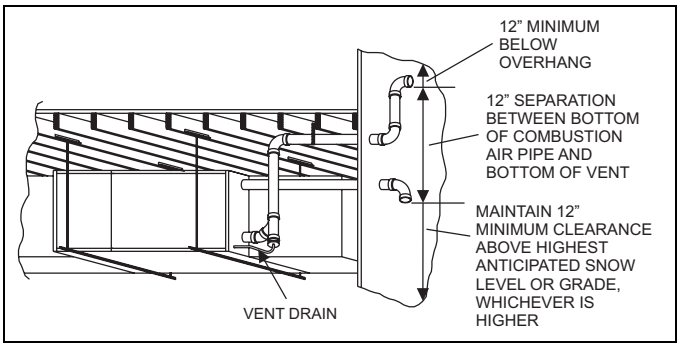


FIGURE 24: Crawl Space Termination Configuration - 2Pipe

VERTICAL VENT APPLICATIONS AND TERMINATION

Roof mounted vertical terminals may be field fabricated. Standard PVC/SRD fittings may be used. If installing a vertical venting system through any unconditioned space such as an attic or crawl space it must be insulated.

1. Observe all clearances listed in vent clearances in these instructions.
2. Termination should be positioned where vent vapors are not objectionable.
3. Termination should be located where it will not be affected by wind gusts, light snow, or allow recirculation of flue gases.
4. Termination should be located where it cannot be damaged, plugged or restricted by tree limbs, leaves and branches.
5. Horizontal portions of the vent system must slope upwards and be supported to prevent sagging. The vent system may be supported by the use of clamps or hangers secured to a permanent part of the structure every 4 ft. (1.22 m).

VENTING MULTIPLE UNITS

Only the sealed combustion system can be used for installations requiring more than one furnace in a structure. A separate sealed combustion air pipe and a separate vent pipe must be installed for each furnace. Do not connect more than one furnace to a combustion air pipe or a vent pipe. The combustion air and vent termination must be located as shown in Figures 25 or 26.

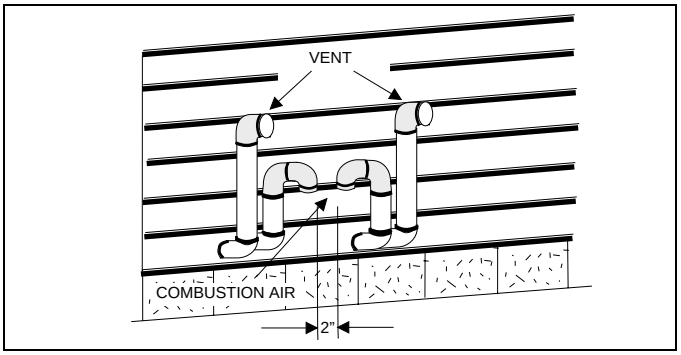


FIGURE 25: Double Horizontal Sealed Combustion Air and Vent Termination

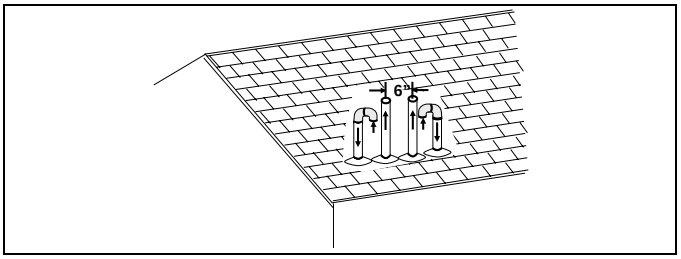


FIGURE 26: Double Vertical Sealed Combustion Air and Vent Termination

COMBUSTION AIR SUPPLY

All installations must comply with Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 or Sections 7.2, 7.3 or 7.4 of CAN/CGA B149.1 or .2 Installation Code - latest editions.

This furnace is certified to be installed with one of three possible combustion air intake configurations.

1. **OUTDOOR COMBUSTION AIR:** This is a sealed combustion air configuration where the combustion air is supplied through a PVC or ABS pipe that is connected to the PVC coupling attached to the burner box and is terminated in the same atmospheric zone as the vent. This type of installation is approved on all models. Refer to Figures 27 and 29.
2. **AMBIENT COMBUSTION AIR:** Combustion air is supplied from the area surrounding the furnace through the combustion air pipe in the furnace casing. The combustion air and the vent pipes are not terminated in the same atmospheric zone. Refer to Figure 28 for vent terminations. Refer to "AIR SOURCE FROM INSIDE THE BUILDING" and "VENT AND SUPPLY AIR SAFETY CHECK" for proper installation.
3. **VENTILATED COMBUSTION AIR:** Combustion air is supplied through a PVC or ABS pipe that is connected to the PVC coupling attached to the burner box and is terminated in a ventilated attic or crawl space. The combustion air and the vent pipes are not terminated in the same atmospheric zone. Refer to Figure 30 for attic termination. Only the combustion air intake may terminate in the attic. The vent must terminate outside.

Outdoor Combustion Air

Combustion Air Intake/Vent Connections

This installation requires combustion air to be brought in from outdoors. This requires a properly sized pipe that will bring air in from the outdoors to the furnace combustion air intake collar on the burner box. The second pipe is the furnace vent pipe.

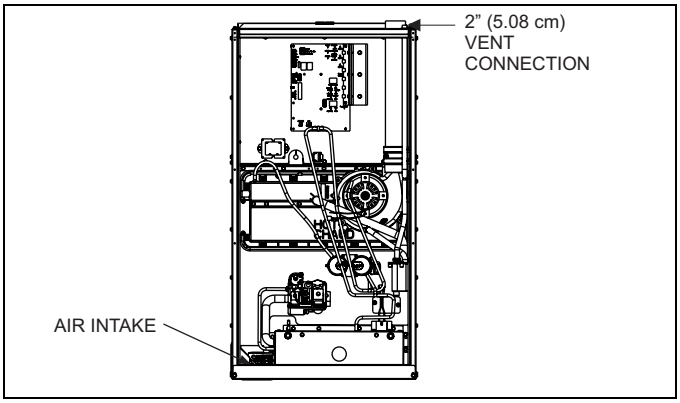


FIGURE 27: Sealed Combustion Air Intake Connection and Vent Connection

The combustion air intake pipe should be located either through the wall (horizontal or side vent) or through the roof (vertical vent). Care should be taken to locate side vented systems where trees or shrubs will not block or restrict supply air from entering the terminal.

Also, the terminal assembly should be located as far as possible from a swimming pool or a location where swimming pool chemicals might be stored. Be sure the terminal assembly follows the outdoor clearances listed in Section II.

The provided 2" diameter rubber sleeve should be installed on the combustion air pipe sticking through the furnace top, when making connection with the outdoor combustion air pipe. This, in combination with the rubber sleeve installed inside the furnace, will facilitate removal of fresh air pipe in front of the blower housing.

Ambient Combustion Air Supply

This type installation will draw the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. It is not piped directly into the burner box. For downflow models combustion air is brought into the furnace through the unit top panel opening. Do not install a pipe into the combustion air pipe at the top of the furnace. Refer to Figure 28. If a 3-way transition is provided, the side or bottom openings can also be used for the same purpose.

⚠WARNING

This type of installation requires that the supply air to the appliance(s) be of a sufficient amount to support all of the appliance(s) in the area. Operation of a mechanical exhaust, such as an exhaust fan, kitchen ventilation system, clothes dryer or fireplace may create conditions requiring special attention to avoid unsatisfactory operation of gas appliances. A venting problem or a lack of supply air will result in a hazardous condition, which can cause the appliance to soot and generate dangerous levels of CARBON MONOXIDE, which can lead to serious injury, property damage and / or death.

An **unconfined space** is not less than 50 cu.ft (1.42 m^3) per 1,000 Btu/hr. (0.2928 kW) input rating for all of the appliances installed in that area.

Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if openings are not furnished with doors.

A **confined space** is an area with less than 50 cu.ft (1.42 m^3) per 1,000 Btu/hr. (0.2928 kW) input rating for all of the appliances installed in that area. The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

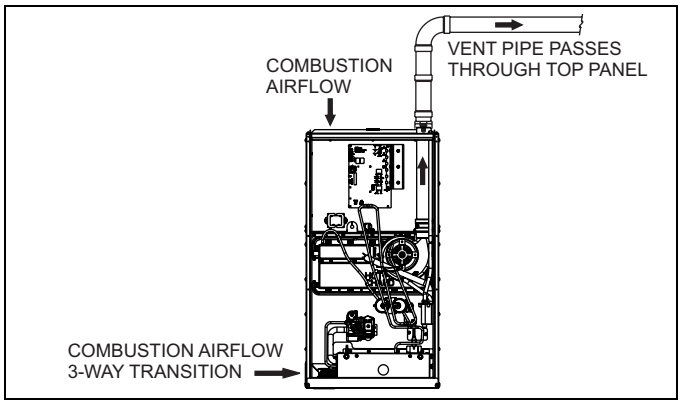


FIGURE 28: Combustion Airflow Path Through The Furnace Casing to the Burner Box

Combustion Air Source From Outdoors

The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known, refer to Table 10, to estimate free area.

TABLE 10: Estimated Free Area

Wood or Metal Louvers or Grilles	Wood 20-25%* Metal 60-70%
Screens+	1/4" (0.635 cm) mesh or larger 100%

* Do not use less than 1/4" (0.635 cm) mesh

\+ Free area or louvers and grilles varies widely; the installer should follow louver or grilles manufacturer's instructions.

Dampers, Louvers and Grilles (Canada Only)

1. The free area of a supply air opening shall be calculated by subtracting the blockage area of all fixed louvers grilles or screens from the gross area of the opening.
2. Apertures in a fixed louver, a grilles, or screen shall have no dimension smaller than 0.25" (0.64 cm).
3. A manually operated damper or manually adjustable louvers are not permitted for use.
4. A automatically operated damper or automatically adjustable louvers shall be interlocked so that the main burner cannot operate unless either the damper or the louver is in the fully open position.

TABLE 11: Free Area

BTUH Input Rating	Minimum Free Area Required for Each Opening		
	Horizontal Duct (2,000 BTUH)	Vertical Duct or Opening to Outside (4,000 BTUH)	Round Duct (4,000 BTUH)
60,000	30 sq. in. (194 cm^2)	15 sq. in. (97 cm^2)	5" (13 cm^2)
80,000	40 sq. in. (258 cm^2)	20 sq. in. (129 cm^2)	5" (13 cm^2)
100,000	50 sq. in. (323 cm^2)	25 sq. in. (161 cm^2)	6" (15 cm^2)
120,000	60 sq. in. (387 cm^2)	30 sq. in. (194 cm^2)	7" (18 cm^2)
EXAMPLE: Determining Free Area. Appliance 1Appliance 2Total Input 100,000 + 30,000 = (130,000 ÷ 4,000) = 32.5 Sq. In. Vertical Appliance 1Appliance 2Total Input 100,000 + 30,000 = (130,000 ÷ 2,000) = 65 Sq. In. Horizontal			

TABLE 12: Unconfined Space Minimum Area in Square Inch

BTUH Input Rating	Minimum Free Area Required for Each Opening
60,000	60 (387 cm^2)
80,000	80 (516 cm^2)
100,000	100 (645 cm^2)
120,000	120 (774 cm^2)

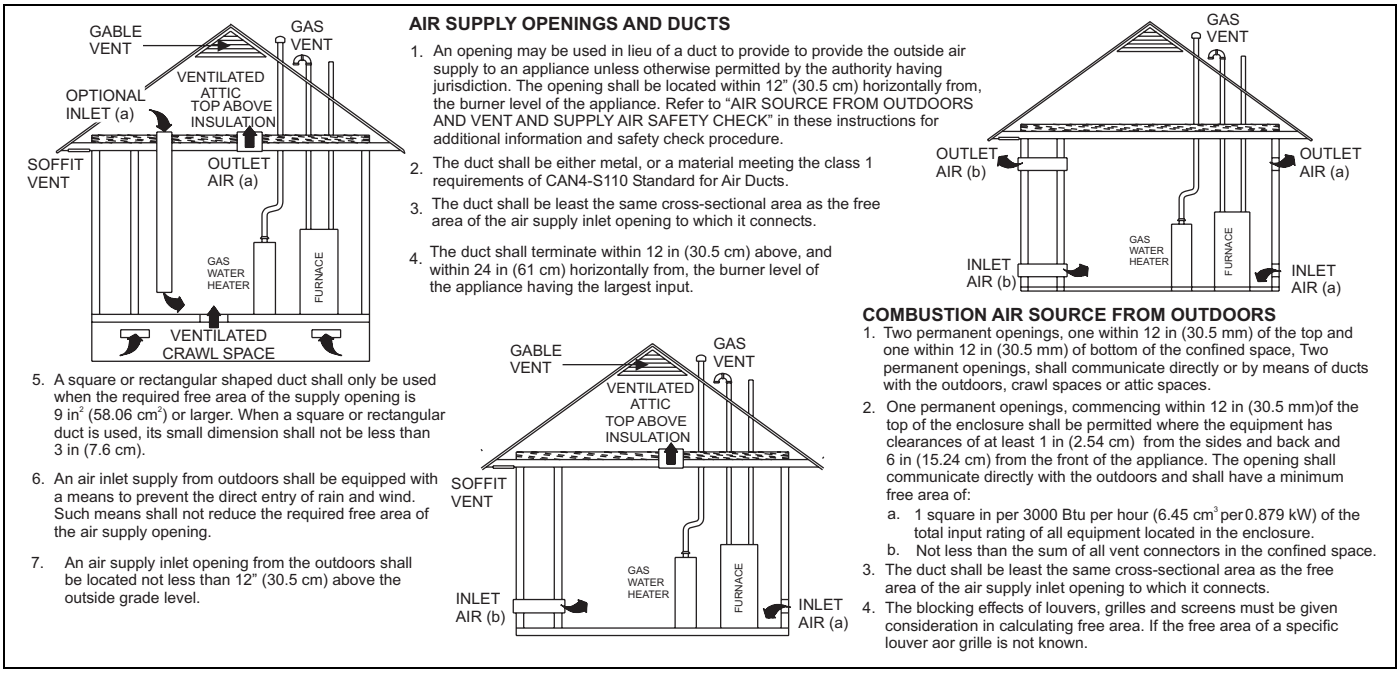

GABLE VENT
GAS VENT
VENTILATED ATTIC TOP ABOVE INSULATION
OPTIONAL INLET (a)
SOFFIT VENT
OUTLET AIR (a)
GAS WATER HEATER
FURNACE
VENTILATED CRAWL SPACE
AIR SUPPLY OPENINGS AND DUCTS
1. An opening may be used in lieu of a duct to provide to provide the outside air supply to an appliance unless otherwise permitted by the authority having jurisdiction. The opening shall be located within 12" (30.5 cm) horizontally from, the burner level of the appliance. Refer to "AIR SOURCE FROM OUTDOORS AND VENT AND SUPPLY AIR SAFETY CHECK" in these instructions for additional information and safety check procedure.
2. The duct shall be either metal, or a material meeting the class 1 requirements of CAN4-S110 Standard for Air Ducts.
3. The duct shall be least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The duct shall terminate within 12 in (30.5 cm) above, and within 24 in (61 cm) horizontally from, the burner level of the appliance having the largest input.
5. A square or rectangular shaped duct shall only be used when the required free area of the supply opening is 9 in² (58.06 cm²) or larger. When a square or rectangular duct is used, its small dimension shall not be less than 3 in (7.6 cm).
6. An air inlet supply from outdoors shall be equipped with a means to prevent the direct entry of rain and wind. Such means shall not reduce the required free area of the air supply opening.
7. An air supply inlet opening from the outdoors shall be located not less than 12" (30.5 cm) above the outside grade level.
GABLE VENT
GAS VENT
VENTILATED ATTIC TOP ABOVE INSULATION
SOFFIT VENT
GAS WATER HEATER
FURNACE
INLET AIR (b)
INLET AIR (a)
GAS VENT
OUTLET AIR (b)
OUTLET AIR (a)
GAS WATER HEATER
FURNACE
INLET AIR (b)
INLET AIR (a)
COMBUSTION AIR SOURCE FROM OUTDOORS
1. Two permanent openings, one within 12 in (30.5 mm) of the top and one within 12 in (30.5 mm) of bottom of the confined space, Two permanent openings, shall communicate directly or by means of ducts with the outdoors, crawl spaces or attic spaces.
2. One permanent openings, commencing within 12 in (30.5 mm)of the top of the enclosure shall be permitted where the equipment has clearances of at least 1 in (2.54 cm) from the sides and back and 6 in (15.24 cm) from the front of the appliance. The opening shall communicate directly with the outdoors and shall have a minimum free area of:
a. 1 square in per 3000 Btu per hour (6.45 cm³ per 0.879 kW) of the total input rating of all equipment located in the enclosure.
b. Not less than the sum of all vent connectors in the confined space.
3. The duct shall be least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver aor grille is not known.

FIGURE 29: Outside and Ambient Combustion Air

Vent and Supply (Outside) Air Safety Check Procedure

Follow the procedure in ANSI Z223.1 National Fuel Gas Code. Refer to the section on the "Recommended Procedure for Safety Inspection of an Existing Appliance" or in Canada B149.1-00 Natural Gas and Propane Installation Code section on "Venting Systems and Air Supply for Appliances" and all local codes. In addition to the procedure specified in ANSI Z223.1, It is recommended that you follow the venting safety procedure below. This procedure is designed to detect an inadequate ventilation system that can cause the appliances in the area to operate improperly causing unsafe levels of Carbon Monoxide or an unsafe condition to occur.

1. Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion or other deficiencies, which could cause an unsafe condition
2. Close all building doors and windows and all doors.
3. Turn on clothes dryers and TURN ON any exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Open the fireplace dampers. Do not operate a summer exhaust fan.
4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
5. Test each appliance (such as a water heater) equipped with a draft hood for spillage (down-draft or no draft) at the draft hood relief opening after 5 minutes of main burner operation. Appliances that do not have draft hoods need to be checked at the vent pipe as close to the appliance as possible. Use a combustion analyzer to check the CO2 and CO levels of each appliance. Use a draft gauge to check for a downdraft or inadequate draft condition.
6. After it has been determined that each appliance properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their normal condition.
7. If improper venting is observed during any of the above tests, a problem exists with either the venting system or the appliance does not have enough combustion air (Supply Air from outside) to complete combustion. This condition must be corrected before the appliance can function safely.

NOTE: An unsafe condition exists when the CO reading exceeds 40 ppm and the draft reading is not in excess of - 0.1 in. W.C. (-25 kPa) with all of the appliance(s) operating at the same time.

8. Any corrections to the venting system and / or to the supply (outside) air system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1-00 Natural Gas and Propane Installation Code (latest editions). If the vent system must be resized, follow the appropriate tables in Appendix G of the above codes.

Ventilated Combustion Air

The ventilated attic space or a crawl space from which the combustion air is taken must comply with the requirements specified in "AIR SOURCE FROM OUTDOORS" in this instruction or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (latest edition). This type installation requires two properly sized pipes. One brings combustion air from a properly ventilated attic space or crawl space and a second pipe that extends from the furnace vent connection (top right of unit) to the exterior of the building. Refer to Table 7 for intake pipe sizing, allowable length and elbow usage. Follow all notes, procedures and required materials in the SEALED COMBUSTION AIR SUPPLY section in these instructions when installing the combustion air pipe from the unit and into a ventilated attic space or crawl space. DO NOT terminate vent pipe in an Attic or Crawl Space.

Ventilated Combustion Air Termination

Refer to Figure 30 for required attic termination for the combustion air intake pipe. For attic termination, use two 90 elbows with the open end in a downward position. Be sure to maintain 12" (30.5 cm) clearance above any insulation, flooring or other material.

A crawl space combustion air installation consists of a straight pipe from the PVC coupling on the burner box that extends into the crawl space and terminates with a 1/4" (0.63 cm) mesh screen and no elbows.

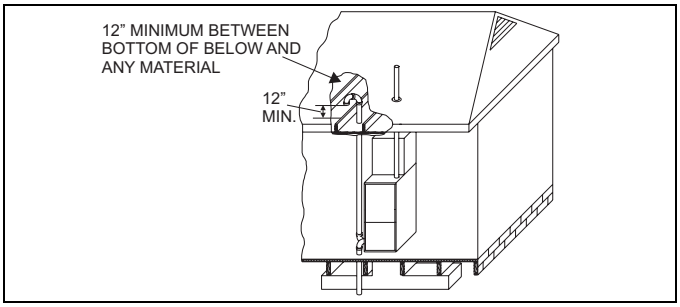


FIGURE 30: Attic Combustion Air Termination

Specially Engineered Installations

The above requirements shall be permitted to be waived where special engineering, approved by the authority having jurisdiction, provides an adequate supply of air for combustion, ventilation and dilution of flue gases.

⚠WARNING

Be sure to instruct the owner not to block this intake pipe.

SECTION VIII: CONDENSATE PIPING

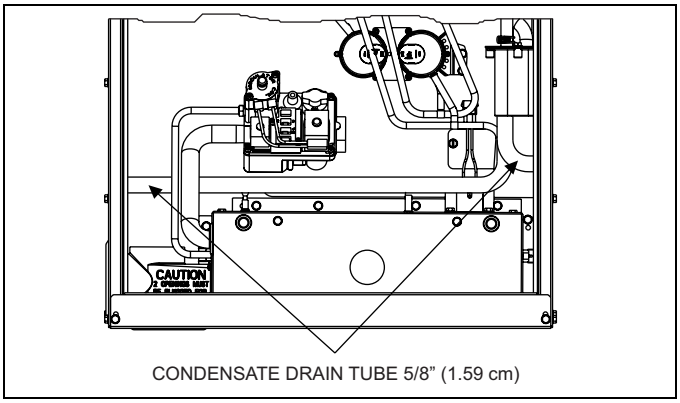


FIGURE 31: Condensate Drain Internal Hose Routing

CONDENSATE DRAIN

The condensate drain connection is provided in the furnace for field installation. It consists of the hoses shown in Table 11, a NPT male connection, and a 1/2” (1.27 cm) female x 3/4” (1.9 cm) PVC slip coupling. Some of the drain hoses will be needed to convert the condensate drain system when the furnace is installed in a horizontal left or right configuration. Refer to Figures 32, 34, 35, 36 and 38 for the condensate hose sizes for condensate drain connections.

IMPORTANT: The condensate drain from the furnace may be connected in common with the drain from an air conditioning coil if allowed by local code.

IMPORTANT: Condensate must be disposed of properly. Follow local plumbing or wastewater codes. The drain line must maintain a 1/4" per foot (0.635 cm per meter) slope to the drain.

CONDENSATE DRAIN TRAP AND DRAIN FREEZE PROTECTION

Special precautions MUST be made if installing furnace in an area, which may drop below freezing. This can cause improper operation or damage to the equipment. If the furnace is installed in an area that has the potential of freezing, the drain line and the drain trap must be protected. Use a 3 to 6 watt per foot at 115 VAC, 40º F (4.4° C) self-regulating, shielded and waterproof heat tape. Wrap the drain trap and the drain line with the heat tape and secure with ties. Follow the heat tape manufacturer's recommendations.

CONDENSATE DRAIN HOSE PART NUMBERS

TABLE 13: Condensate Drain Hose

Part Number	Hose Number	Description
028-15156-000	#1	Drain tube - Condensate pan (Down flow)
028-15176-000	#2	Drain tube - Inducer (Horizontal RT.)
-Vent system / Down flow)		
028-15168-000	#3	Drain tube - Inducer (Down flow)
028-15176-000	#4	Drain tube - Rain gutter (Down flow & Horizontal RT.)
028-15176-000	#5	Drain tube - After Tee (Down flow)
028-15196-000	#6	Drain tube – Upper rain gutter (Horizontal LT.)
028-15169-001	#7	Drain tube - After Tee (Horizontal RT.)
028-13309-004	#8	Drain tube - P-trap (All models)
028-15158-000	#9	Drain tube - Vent system (Horizontal LT.)
- Before Tee (Horizontal RT.)		
028-15197-000	#10	Drain tube – Condensate pan (Horizontal – drain closer to the front of the furnace, both LT & RT)
Hoses #2, #4, #5, along with a barbed nipple, and a barbed tee are part of condensate hose assembly 028-15176-000.		

DOWNFLOW/HORIZONTAL CONDENSATE INTERNAL DRAIN CONFIGURATIONS

Downflow - Refer to Figure 32

Furnace is shipped with one end of condensate hose #2 left open in the furnace. If the provided Wye's drain is aligned with the opening in the top of the furnace, hose #2 can be used. If it is desired that the Wye and street elbow assembly point away from the opening in the casing top, then the #2 hose will have to be replaced with provided #9 hose. The dogleg end of hose #9 hose should be installed on the drain of the Wye.

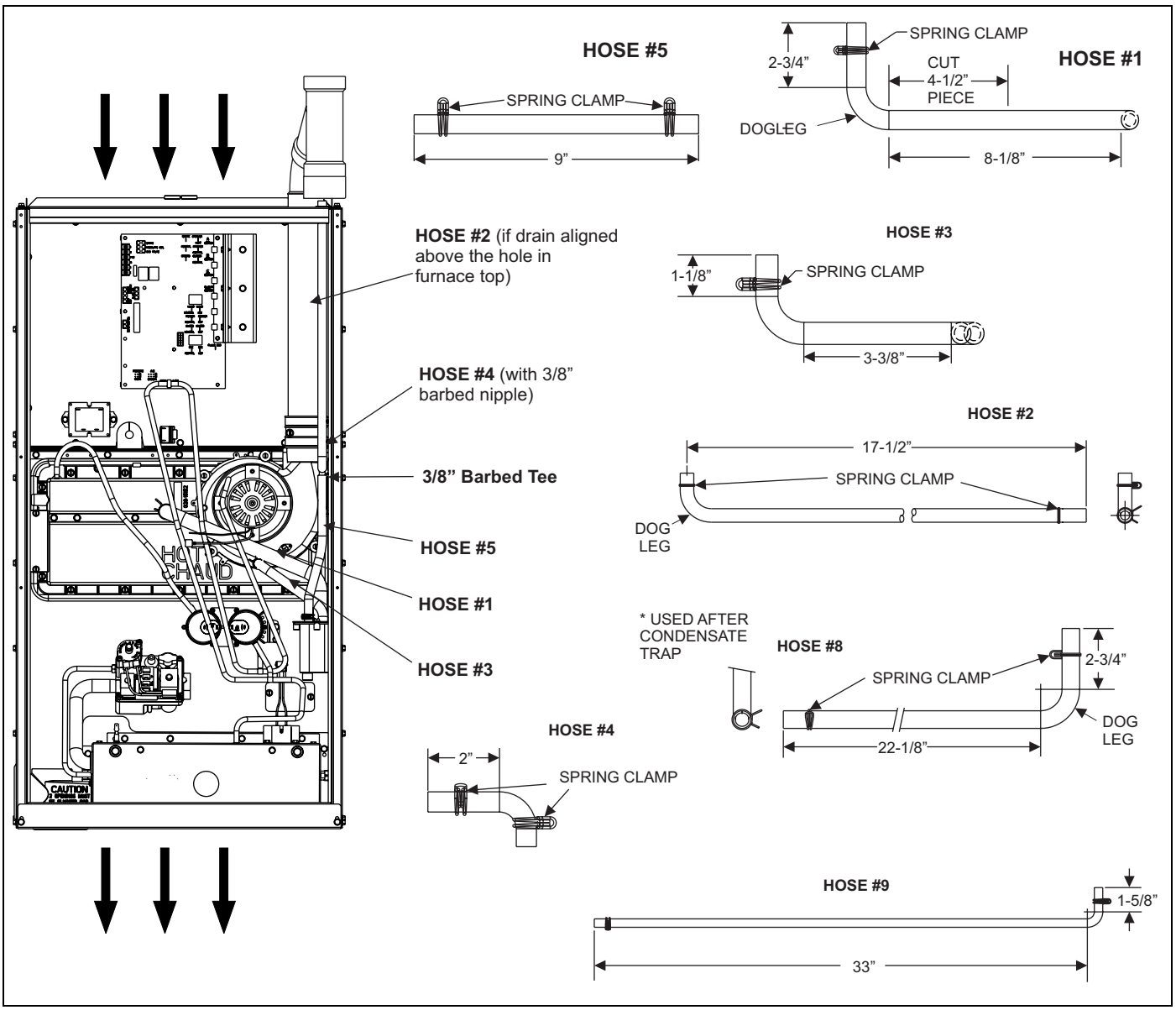


FIGURE 32: Downflow Condensate Drain Hose Configuration

Horizontal Left Air Flow (Inducer Low) - Refer to Figures 33 and 34

1. Remove all the condensate hoses inside the furnace, leaving the 3/8" barbed nipple and hose # 4, both factory installed, in the rain gutter.
2. Remove the condensate trap and its bracket from inside the furnace, saving the screws for use later.
3. Remove the yellow cap from the top drain of the rain gutter and install loosely packed 3/8" barbed nipple in it.
4. Remove the large condensate cap from the side of the condensate pan and install it on the middle drain of the condensate pan, from where #1 hose was removed.
5. Install longer dogleg end of hose #10 through the casing hole on to the side drain of the condensate pan, where cap was removed in step #4. Some lubricant may have to be used to facilitate this installation as the hose is designed as a tight fit over the condensate drain. The other, shorter, dogleg end of hose #10 should be installed into the large recessed drain in the condensate trap.
6. Install the condensate trap bracket, with the condensate trap, on to the front side of the furnace, using the screws removed in step #1.
7. Switch the blocked condensate hose to the condensate tap on the bottom of the condensate pan (close to the inducer).
8. Install hose #9 between the external drain on the Wye and the condensate trap; with the dogleg end installed on the protruded (stub) drain of the condensate trap. The length of hose #9 may have to be trimmed to ensure proper condensate drainage.
9. Remove all condensate hoses off the 3/8" barbed tee.
10. Cut 1-1/2" length of straight 3/8" hose off of hose #5 and install it on the 3/8" barbed tee. The other end of the 1-1/2" hose should be installed on the welded opening on the condensate trap.
11. Install one end of the 3/8" barbed tee on hose #4 as shown. Ensure that hose #4 follows a gradual downward slope all the way to the barbed tee.
12. Install hose #6 between the top drain of the rain gutter of the inducer and the remaining open end of 3/8" barbed tee.
13. Ensure that all hoses are properly installed, have no kinks, and are draining properly. All hoses on the condensate trap should be pushed all the way down to ensure against leakage.

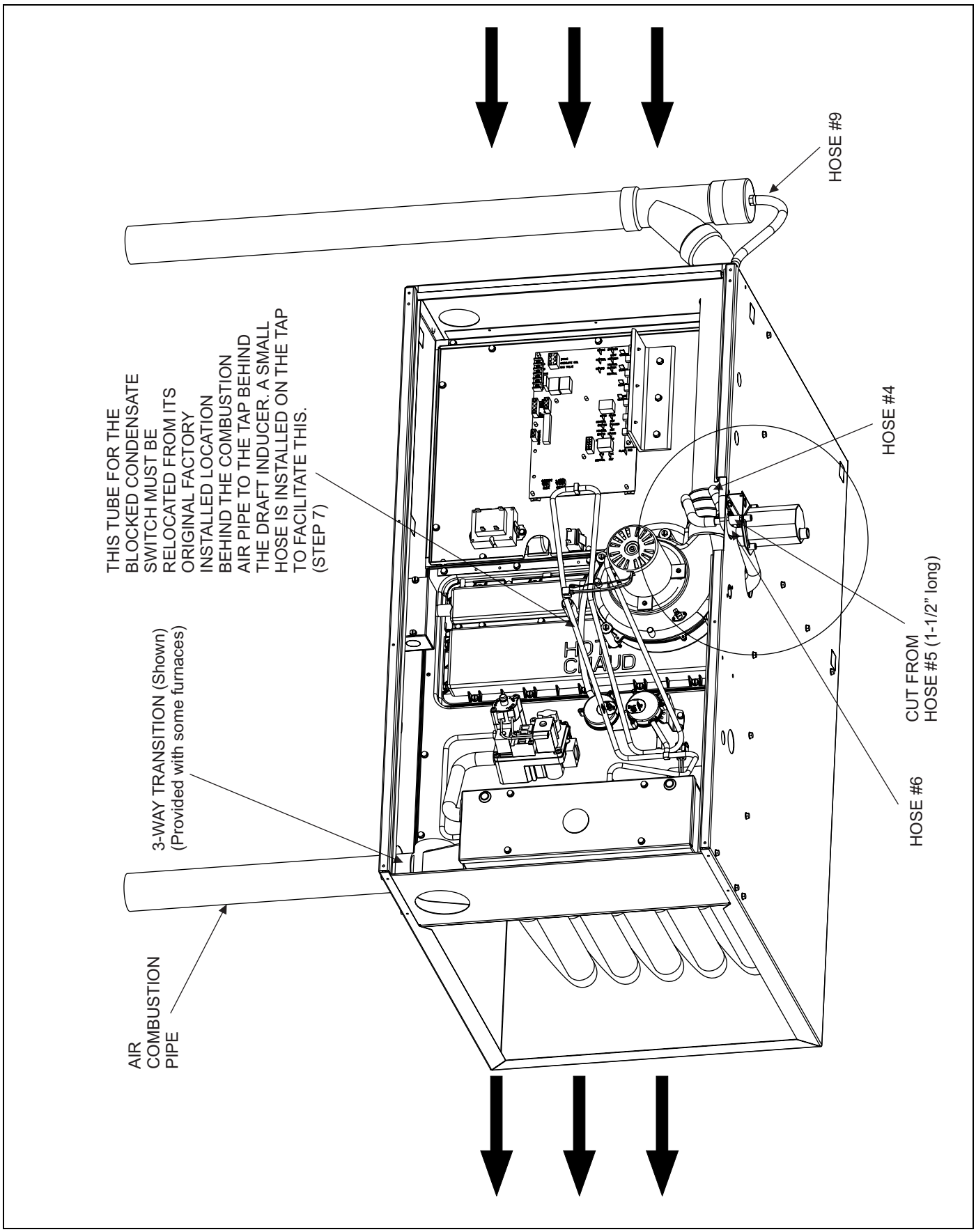

HOSE #9
HOSE #4
THIS TUBE FOR THE BLOCKED CONDENSATE SWITCH MUST BE RELOCATED FROM ITS ORIGINAL FACTORY INSTALLED LOCATION BEHIND THE COMBUSTION AIR PIPE TO THE TAP BEHIND THE DRAFT INDUCER. A SMALL HOSE IS INSTALLED ON THE TAP TO FACILITATE THIS. (STEP 7)
3-WAY TRANSITION (Shown) (Provided with some furnaces)
CUT FROM HOSE #5 (1-1/2" long)
HOSE #6
AIR COMBUSTION PIPE

FIGURE 33: Horizontal Left Condensate Drain Hose Configuration

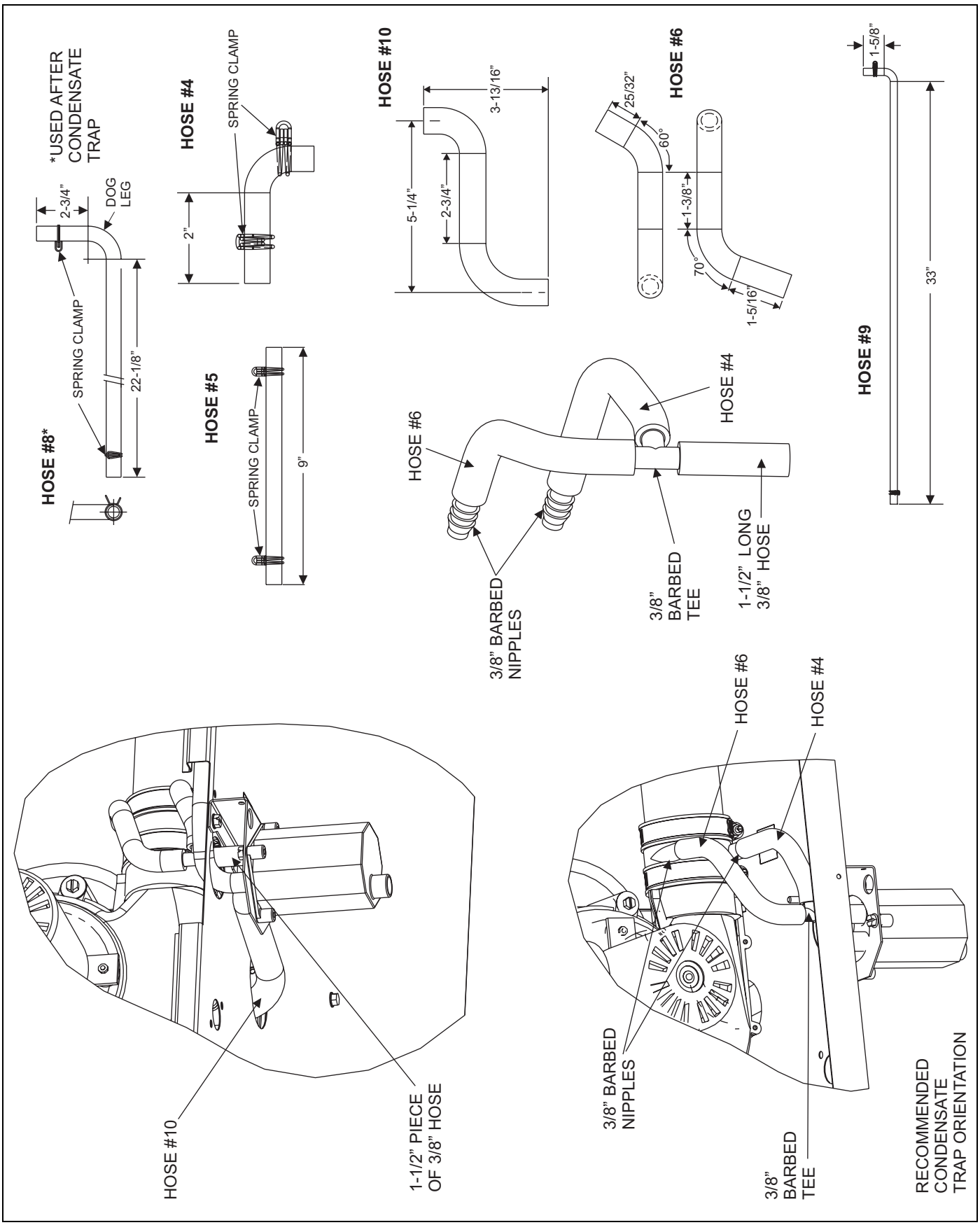


FIGURE 34: Horizontal Left Condensate Drain Hose Configuration

Horizontal Right Air Flow (Inducer High)
Refer to Figures 35-38

Installation with condensate trap bracket (Front of casing):
Refer to Figure 35 and 36

1. Remove the 2" knockout on the casing side, away from the inducer motor.
2. Remove all the condensate hoses inside the furnace, including the 3/8" barbed nipple, factory installed, in the rain gutter.
3. Remove the drain cap from the bottom rain gutter drain and insert the 3/8" barbed nipple removed above in the bottom rain gutter drain. Place the cap, just removed, to the other side of the rain gutter on the inducer.
4. Remove the condensate trap and its bracket from inside the furnace, saving the screws for later use.
5. Remove the large condensate cap from the side of the condensate pan and install it on the middle drain of the condensate pan, from where #1 hose was removed.
6. Install longer dogleg end of hose #10 through the casing hole on to the side drain of the condensate pan, where cap was removed in step #3. Some lubricant may have to be used to facilitate this installation as the hose is designed to be a tight fit over the condensate drain. The other, smaller, dogleg end of hose #10 should be installed into the large recessed drain in the condensate trap.
7. Install the condensate trap bracket, with the condensate trap, on to the front side of the furnace, using the screws removed in step #1.
8. Install the dogleg end of hose #9 on the Wye drain and route the hose through the opening on top of the furnace, as shown. Install the other end of the #9 hose to the barbed tee, inside the furnace.
9. Install the dogleg end of hose #4 to the rain gutter on the inducer. The other end of hose #4 should be installed on the 3/8" barbed tee.
10. Install one end of hose #7 on the 3/8" barbed tee inside the furnace. Guide the other end of hose #7 towards the condensate trap, and install it on the tap on the condensate trap.
11. Install the dogleg end of hose #2 on the bottom drain of the inducer. Guide the other end of hose #2 towards the condensate trap, and install it on the small recessed drain in the condensate trap.
12. Ensure that all hoses are properly installed, have no kinks, and are draining properly. All hoses on the condensate trap and condensate pan should be pushed all the way down to ensure against leakage and performance. Some hoses may have to be trimmed for proper fit.

NOTE: The condensate trap can also be installed on the 2" knockout opening, in this configuration, using the provided condensate trap bracket. Some modifications may, however, have to be made to the condensate hoses.

⚠ CAUTION

Ensure all condensate hoses are pushed all the way down on the condensate trap, barbed fittings, and condensate pan drains.

⚠ CAUTION

Plug all unused condensate trap, condensate pan and inducer drain connection points using plugs provided.

Installation with condensate trap bracket (Back of casing):
Refer to Figure 37 and 38

1. Remove the 2" knockout on the casing side, away from the inducer motor.
2. Remove all the condensate hoses inside the furnace, including the 3/8" barbed nipple, factory installed, in the rain gutter.
3. Remove the drain cap from the bottom rain gutter drain and insert the 3/8" barbed nipple removed above in the bottom rain gutter drain. Place the cap, just removed, to the other side of the rain gutter on the inducer.
4. Remove the condensate trap and it's bracket from inside the furnace, saving the screws for later, use.
5. Remove the large condensate cap from the side of the condensate pan and install it on the middle drain of the condensate pan, from where #1 hose was removed.
6. Do not remove condensate trap from the condensate trap bracket.
7. Cut 2-1/2" straight piece from hose #1 and install it through the knockout opening in the casing on the side of the condensate pan, from where the cap was previously removed. Insert the other end of the hose into the large recessed drain on the condensate trap.
8. Install the condensate trap bracket to the 2" inch hole on the side of casing, using existing holes, lining up the condensate pan opening with the larger opening on the condensate trap.
9. Install the dogleg end of hose #9 on the Wye drain and route the hose through the opening on top of the furnace. Install the other end of the #9 hose to the barbed tee, inside the furnace.
10. Install the dogleg end of hose #4 on 3/8" barbed nipple, in the rain gutter. The other end of hose #4 should be installed on the 3/8" barbed tee.
11. Install one end of hose #7 on the 3/8" barbed tee inside the furnace. Guide the other end of hose #7 towards the condensate trap, and install it on the tap on the condensate trap
12. Install the dogleg end of hose #2 on the bottom drain of the inducer. Guide the other end of hose #2 towards the condensate trap, and install it on the small recessed drain in the condensate trap.
13. Ensure that all hoses are properly installed, have no kinks, and are draining properly. All hoses on the condensate trap should be pushed all the way down to ensure against leakage. All hoses on the condensate pan should be pulled all the way up to ensure proper operation.

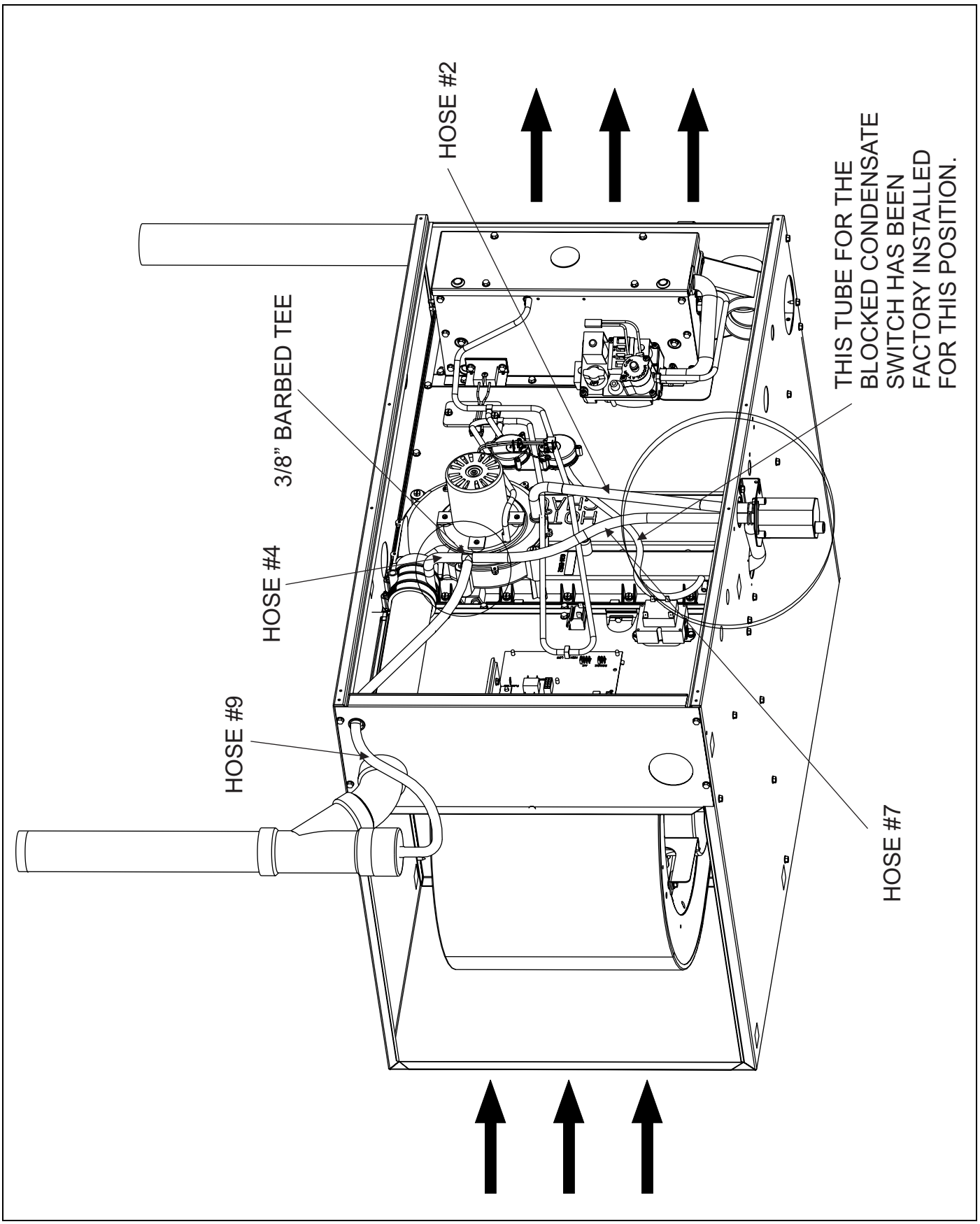


FIGURE 35: Horizontal Right Condensate Drain Hose Configuration (Option 1 - Front of Casing)

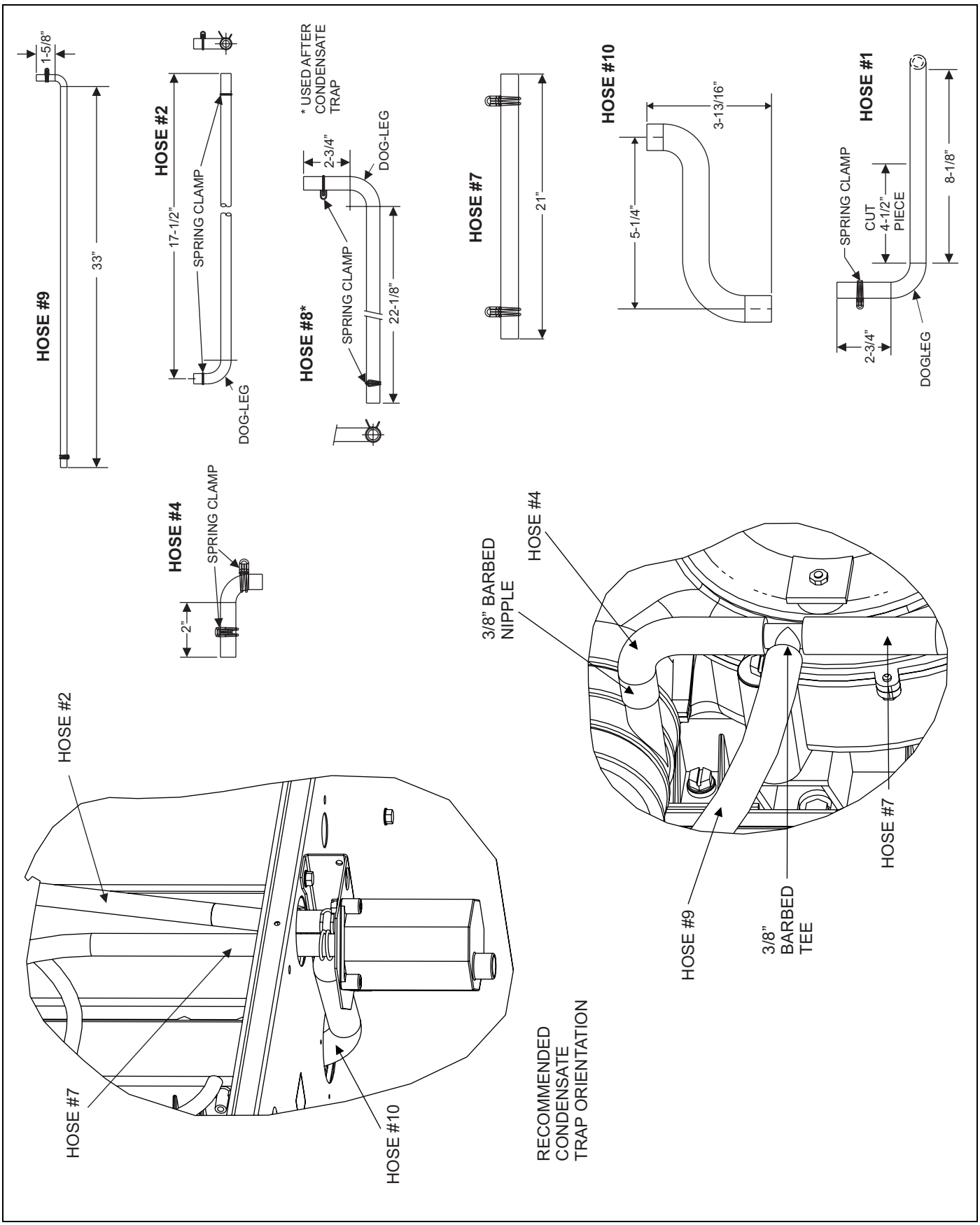


FIGURE 36: Horizontal Right Condensate Drain Hose Configuration (Option 1 - Front of Casing)

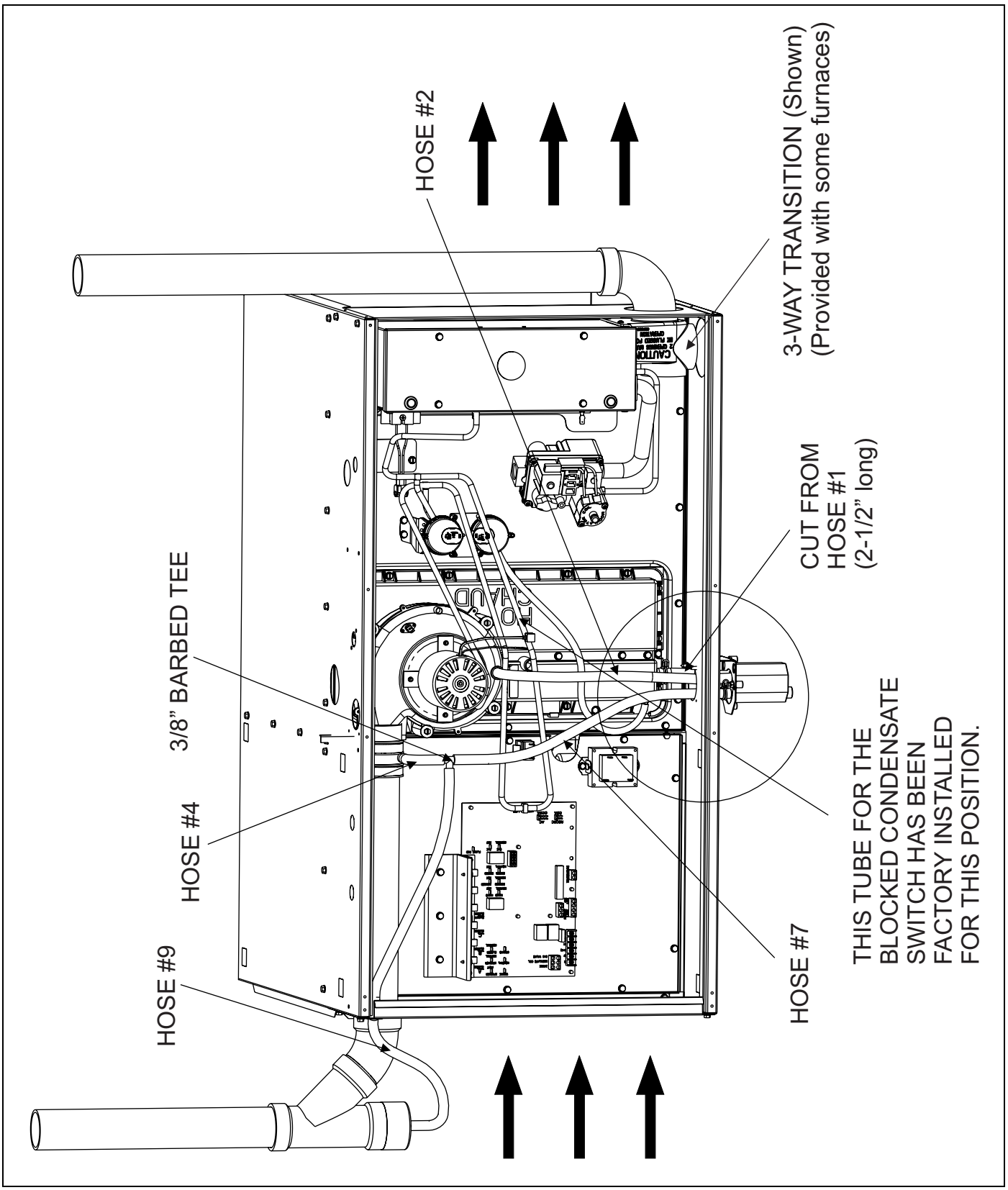


FIGURE 37: Horizontal Right Condensate Drain Hose Configuration (Option 2 - Back of Casing)

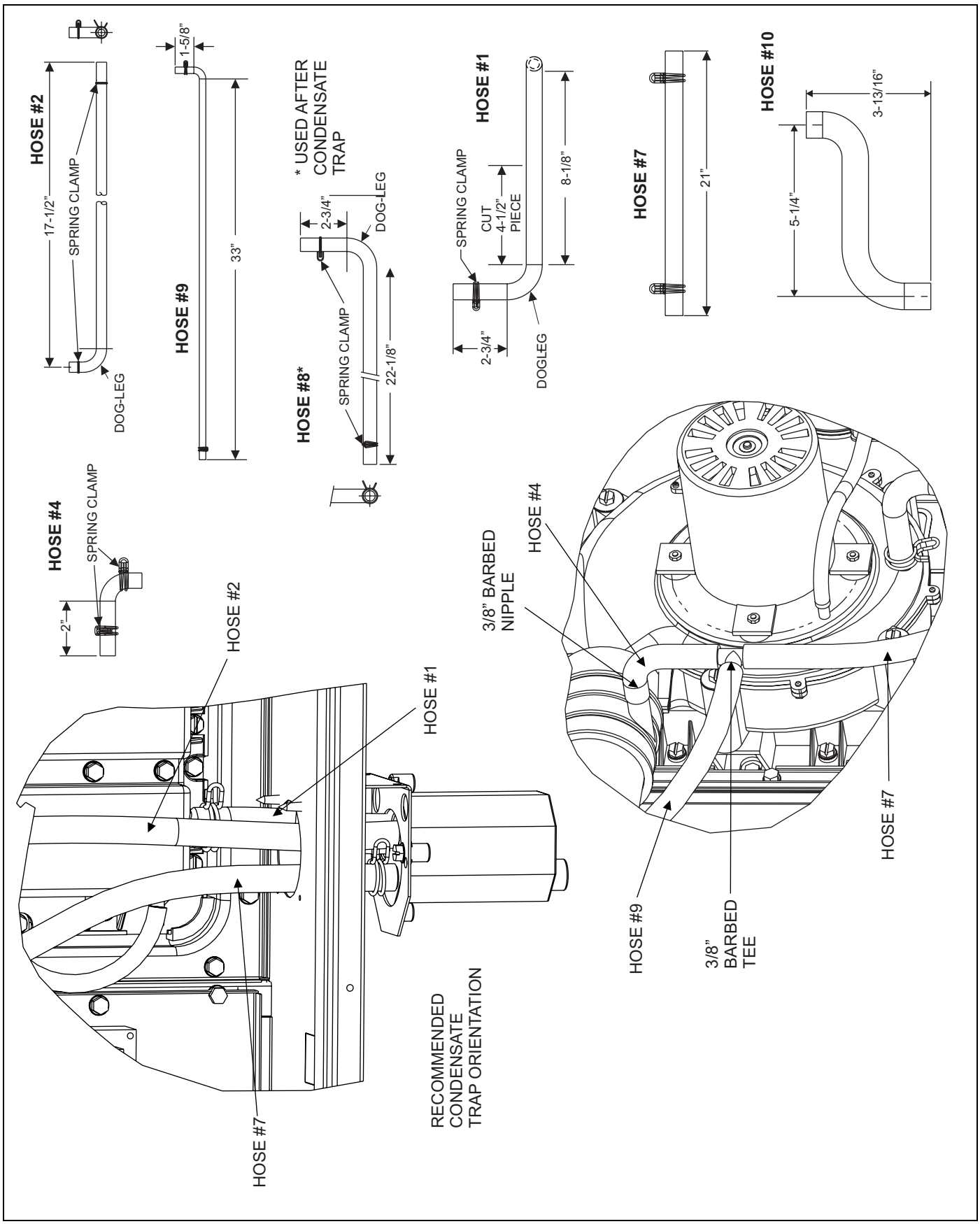


FIGURE 38: Horizontal Right Condensate Drain Hose Configuration (Option 2 - Back of Casing)

CONDENSATE DRAIN TERMINATION

DO NOT terminate condensate drain in a chimney, or where the drain line may freeze. The line must terminate at an inside drain to prevent freezing of the condensate and possible property damage. DO NOT trap the drain line at any other location than at the condensate drain trap supplied with the furnace. A condensate sump pump MUST be used if required by local codes, or if no indoor floor drain is available. The condensate sump pump must be approved for use with acidic condensate.

CONDENSATE DRAIN PRE-START UP PROCEDURE

The condensate trap must be filled with water before putting the furnace into operation. Perform the following procedures only after the condensate trap has been properly piped to a drain connection using the procedure in this instruction. The recommended procedure is as follows:

1. Disconnect the condensate drain hose from the induced draft blower discharge.
2. Elevate this hose and fill with water using a funnel.
3. Replace the condensate drain hose and clamps. If this procedure is not followed, the unit may not properly drain on initial start up.

SECTION IX: SAFETY CONTROLS

CONTROL CIRCUIT FUSE

A 3-amp fuse is provided on the control circuit board to protect the 24-volt transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located on the control board.

BLOWER DOOR SAFETY SWITCH

This unit is equipped with an electrical interlock switch mounted in the blower compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed.
Electrical supply to this unit is dependent upon the panel that covers the blower compartment being in place and properly positioned.

⚠ CAUTION

Main power to the unit must still be interrupted at the main power disconnect switch before any service or repair work is to be done to the unit. Do not rely upon the interlock switch as a main power disconnect.
Blower and burner must never be operated without the blower panel in place.

ROLLOUT SWITCH CONTROLS

These controls are mounted on the burner box assembly. If the temperature in the burner box exceeds its set point, the ignition control and the gas valve are de-energized. The operation of this control indicates a malfunction in the combustion air blower, heat exchanger or a blocked vent pipe connection. Corrective action is required. These are manual reset controls that must be reset before operation can continue.

PRESSURE CONTROLS

Pressure Sensor - This furnace is equipped with a pressure sensor mounted on the furnace control board. This sensor monitors combustion airflow through furnace and piping systems. If any of the conditions listed above are detected by the pressure sensor, the control board will prevent a hazardous condition from occurring by speeding up the combustion blower motor in order to maintain adequate combustion airflow. If the combustion blower is already turning at full speed, the furnace control will then start reducing the input to the furnace in order to maintain proper combustion with the amount of combustion airflow available. If there is not enough combustion air available to give proper combustion even at the minimum input rate (35%), the control will close the gas valve and shut off the burners.

Pressure Switch - This furnace is equipped with a pressure switch mounted on the furnace vestibule panel. This switch monitors the flow through the combustion air/vent system. The switch will close at the beginning of each cycle when adequate combustion airflow is established. However, this switch may be open under certain conditions when the burners are lit. The pressure sensor is the primary flow sensor.

1. Blockage of combustion air piping
2. Blockage of vent piping or vent terminal
3. Failure of combustion air blower motor or blower wheel.
4. Blockage of condensate drain piping.

LIMIT CONTROLS

Limit Switch - This furnace is equipped with a high temperature limit control mounted to the left side of the furnace vestibule panel. This limit switch will open and shut off gas to the burners if it detects excessive air temperature in the furnace, which can be caused by any of the following conditions:

1. Dirty filter
2. Failure of the circulating blower motor or wheel
3. Too many supply or return registers closed or blocked.

Temperature Sensor - This furnace is also equipped with a temperature sensor mounted to the vestibule panel, near the side of the burner. This sensor monitors the temperature of the air being supplied to the home. If the sensor detects air temperature higher than its setting, the furnace control will first speed up the circulating blower motor in order to try to increase the amount of airflow being delivered, thereby reducing the air temperature. If the blower motor is already turning at full speed, the control will then start reducing the input to the furnace to try to reduce the air temperature. If the supply air temperature is too high even at the minimum input rate (35%), the control will close the gas valve and shut off the furnace.

SECTION X: START-UP AND ADJUSTMENTS

The initial start-up of the furnace requires the following additional procedures:

IMPORTANT: All electrical connections made in the field and in the factory should be checked for proper tightness.

When the gas supply is initially connected to the furnace, the gas piping may be full of air. In order to purge this air, it is recommended that the ground union be loosened until the odor of gas is detected. When gas is detected, immediately retighten the union and check for leaks. Allow five minutes for any gas to dissipate before continuing with the start-up procedure.

⚠ CAUTION

Perform the following procedures only after the condensate trap has been properly piped to a drain connection using the procedure in this instruction. Be sure proper ventilation is available to dilute and carry away any vented gas.

TOOLS AND INFORMATION THAT WILL BE REQUIRED IN ORDER TO PROPERLY PERFORM THE FURNACE STARTUP PROCEDURE.

1. Call the local gas supplier to obtain heating value of the natural gas. If you cannot obtain the heating valve of the gas from the gas supplier, you may use a default value of 1030 BTU/SCF (38.8 MJ / m^3).
2. You will need a thermometer or portable digital thermometer to read the supply and return air temperatures.
3. You will need a U-tube manometer or digital equipment that has the ability to read pressures between 0 – 15" in.w.c (0 - 3.73 kPa) in order to measure the gas line and the manifold pressures.
4. You will need a 3/16" Allen wrench for the pressure port plugs in the gas valve.
5. You will need 2 pieces of 1/8" (0.3 cm) ID flexible tubing that is 12" (30 cm) in length, 2 – pieces of 1/8" (0.3 cm) tubing that are 4" (10.1 cm) in length, a 1/8" (0.3 cm) tee and a 1/8" (0.3 cm) adapter to connect the U-tube manometer or the digital pressure measuring equipment to the gas valve pressure ports.

There is an accessory kit (1PK0601) available from Source 1, which has the following items:

- 1 - 12" (30 cm) length x 1/8" (0.3 cm) diameter tubing
- 2 – pieces of 4" (10 cm) length x 1/8" (0.3 cm) diameter tubing
- 1 - 5/16" (0.8 cm) tee
- 1 – 5/16" (0.8 cm) x 1/8" (3.175 mm) reducing coupling
- 1 – 1/8" (0.3 cm) adapter

There is a accessory kit (1PK0602) available from Source 1, which has the following items:

- 12" (30 cm) length x 1/8" (0.3 cm) diameter tubing
- 2 – pieces of 4" (10 cm) length x 1/8" (0.3 cm) diameter tubing
- 1 - 5/16" (0.8 cm) tee
- 1 – 5/16" (0.8 cm) x 1/8" (0.3 cm) reducing coupling
- 1 – 1/8" (0.3 cm) adapter
- 1 - Dwyer – Manometer

These items are required in order to properly perform the required startup procedure.

GAS PIPING LEAK CHECK

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

IMPORTANT: Burner ignition may not be satisfactory on first startup due to residual air in the gas line or until gas manifold pressure is adjusted. The ignition control will make three attempts to light before locking out.

It is recommended that when the gas supply is first connected to the furnace, the ground union be loosened until the odor of gas is detected. When gas is detected, immediately tighten the union and check for gas leaks. Allow five minutes for any gas to dissipate before continuing with the startup procedure. Be sure that proper ventilation is available to dilute and carry away any vented gas.

With furnace in operation, check all of the pipe joints, gas valve connections and manual valve connections for leakage using an approved gas detector, a non-corrosive leak detection fluid or other leak detection methods. Take appropriate action to stop any leak. If a leak persists, replace the faulty component.

The furnace and its equipment shutoff valve must be disconnected from the gas supply during any pressure testing of that system at test pressures in excess of 1/2 PSI (3.45 kPa).

The furnace must be isolated from the gas supply piping system by closing the equipment shutoff valve during any pressure testing of the gas supply system.

SETUP TEST MODE

During normal operation, the furnace input rate can vary between 35% and 100% of full nameplate input, making it difficult to check for proper operation. To help with the furnace startup process, the control has a TEST MODE available that allows the furnace input rate to stay at a constant input rate. To access this TEST MODE perform the following sequence:

1. With power to the board on and with no thermostat calls (no call for heating, cooling or continuous fan), push and hold the TEST button on the board for one second. The LED on the board will glow red.
2. Release the TEST button. The LED on the board will flash a rapid green signal, indicating that TEST MODE is activated.
3. Turn the thermostat to call for heat (R & W signal).
4. The furnace will light and operate at high (100%) firing rate. The furnace firing rate should be checked at this level to confirm that the furnace is not overfired or underfired.
5. To run the furnace at minimum rate (35%), press the ERROR button once. The LED will flash one green flash to confirm.
6. To run the furnace at a middle rate (70%), press the ERROR button twice within a five-second period. The LED will flash green two times to confirm.
7. To again operate the furnace at maximum (100%) rate, press the ERROR button three times within a five-second period. The LED will flash green three times to confirm.
8. If the thermostat call for heat is removed, the LED will flash a rapid green signal, indicating that the furnace is still in TEST MODE.
9. When startup tests are completed, turning off power to the board will take the furnace out of TEST MODE and will restore normal operation. The furnace will automatically return to normal operation after 150 minutes if power is not cycled.

CALCULATING THE FURNACE INPUT (NATURAL GAS)

NOTE: Burner orifices are sized to provide proper input rate using natural gas with a heating value of 1030 BTU/Ft^3 (38.4 MJ/m^3). If the heating value of your gas is significantly different, it may be necessary to replace the orifices.

NOTE: Front door of burner box must be secured when checking gas input.

1. Turn off all other gas appliances connected to the gas meter.
2. At the gas meter, measure the time (with a stop watch) it takes to use 2 cubic ft. (0.0566 m^3.) of gas.
3. Calculate the furnace input by using one of the following equations.

In the USA use the following formula to calculate the furnace input.

For natural gas multiply the heat content of the gas BTU/SCF or Default 1030 BTU/SCF (38.4 MJ/m^3), times 2 cubic ft. (0.056 m) of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time (In seconds) it took to measure 2 cubic ft. (0.056 m) of gas from the gas meter.

For propane (LP) gas multiply the heat content of the gas BTU/SCF or Default 2500 BTU/SCF (93.13 MJ/m^3), times 1 cubic ft. (0.028 m) of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time (In seconds) it took to measure 1 cubic ft. (0.028 m) of gas from the gas meter.

The formula for US input calculation using a cubic foot gas meter:

$\frac{BTU/ft^3 \times 2\ cu.ft. \times 0.960 \times 3600}{Seconds\ it\ took\ to\ measure\ the\ 2\ cu.ft.\ of\ gas}$	=	BTU/H	$\frac{BTU/ft^3 \times 1\ cu.ft. \times 0.960 \times 3600}{Seconds\ it\ took\ to\ measure\ the\ 1\ cu.ft.\ of\ gas}$	=	BTU/H
NATURAL GAS INPUT CALCULATION EXAMPLE: $\frac{1030 \times 2 \times 0.960 \times 3600}{90.5}$ Natural Gas BTU/SCF 1030	=	78,666.90	**PROPANE (LP) GAS INPUT CALCULATION** EXAMPLE: $\frac{2500 \times 1 \times 0.960 \times 3600}{108}$ Propane Gas BTU/SCF 2500	=	80,000.00

In Canada you will use the following formula to calculate the furnace input if you are using a cubic foot gas meter.

For Natural Gas multiply the Heat content of the gas MJ/m^3 (or Default 38.4), times 2 cubic ft. of gas x 0.028 to convert from cubic feet to cubic meters measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 2 cubic ft. (0.056 m) of gas from the gas meter.

For Propane (LP) Gas multiply the Heat content of the gas MJ/m^3 (or Default 93.13), times 1 cu. ft. of gas x 0.028 to convert from cubic feet to cubic meters measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 1 cubic ft. (0.028 m) of gas from the gas meter.

The formula for metric input calculation using a cubic foot gas meter:

$\frac{MJ/m^3 \times 2\ cu.ft. \times 0.028 \times 0.960 \times 3600}{Seconds\ it\ took\ to\ measure\ the\ 2\ cu.ft.\ of\ gas}$	=	MJ/H	x	0.2777	=	kW	x	3412.14	=	BTU/H
NATURAL GAS INPUT CALCULATION EXAMPLE: $\frac{38.4 \times 2 \times 0.028 \times 0.960 \times 3600}{90.5}$ Natural Gas BTU/SCF 1030 = 38.4 MJ/m^3	=	82.12	x	0.2777	=	22.80	x	3412.14	=	77,796.80
PROPANE (LP) GAS INPUT CALCULATION EXAMPLE: $\frac{93.13 \times 1 \times 0.028 \times 0.960 \times 3600}{108}$ Propane Gas BTU/SCF 2500 = 93.13 MJ/m^3	=	83.44	x	0.2777	=	23.17	x	3412.14	=	79,063.70

In Canada use the following formula to calculate the furnace input if you are using a gas meter that measures cubic meters.

For Natural Gas multiply the Heat content of the gas MJ/m^3 (or Default 38.4), times 0.10 m^3 of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 0.10 m^3 of gas from the gas meter.

For Propane (LP) Gas multiply the Heat content of the gas MJ/m^3 (or Default 93.13), times 0.10 m^3 of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 0.10 m^3 of gas from the gas meter.

The formula for metric input calculation using a cubic foot gas meter:

$\frac{MJ/m^3 \times m^3 \times 0.960 \times 3600}{Seconds\ it\ took\ to\ measure\ the\ 0.10\ m^3\ of\ gas}$	=	MJ/H	x	0.2777	=	kW	x	3412.14	=	BTU/H
NATURAL GAS INPUT CALCULATION EXAMPLE: $\frac{38.4 \times 0.1 \times 0.960 \times 3600}{160}$ Natural Gas BTU/SCF 1030 = 38.4 MJ/m^3	=	82.94	x	0.2777	=	23.03	x	3412.14	=	78,581.60
PROPANE (LP) GAS INPUT CALCULATION EXAMPLE: $\frac{93.13 \times 0.1 \times 0.960 \times 3600}{387}$ Propane Gas BTU/SCF 2500 = 93.13 MJ/m^3	=	83.17	x	0.2777	=	23.09	x	3412.14	=	78,805.20

DO NOT ADJUST the manifold pressure regulator if the actual input is equal to or within 8% less than the furnace input specified on the rating plate or if the furnace rise is above the specified rise range on the rating plate.

If the actual input is significantly higher than the furnace input specified on the rating plate then replace the gas orifices with the gas orifices of the proper size for the type of gas you are using.

⚠ CAUTION

Be sure to relight any gas appliances that were turned off at the start of this input check.

TABLE 14: Inlet Gas Pressure Range

INLET GAS PRESSURE RANGE		
	Natural Gas	Propane (LP)
Minimum	4.5” W.C. (1.12 kPa)	8.0” W.C. (1.99 kPa)
Maximum	10.5” W.C. (2.61 kPa)	13.0” (3.24 kPa) W.C.

IMPORTANT: The inlet gas pressure operating range table specifies what the minimum and maximum gas line pressures must be for the furnace to operate safely. The gas line pressure **MUST BE**

- 7” W.C. (1.74 kPA) for Natural Gas
- 11” W.C. (2.74 kPA) for Propane (LP) Gas

in order to obtain the BTU input specified on the rating plate and/or the nominal manifold pressure specified in these instructions and on the rating plate.

ADJUSTMENT OF MANIFOLD GAS PRESSURE

Follow the appropriate section in the instructions below. Refer to Figure 39 for a drawing of the locations of the pressure ports on the gas valve.

Turn gas off at the ball valve or gas cock on gas supply line before the gas valve.

1. The manifold pressure must be taken at the port marked OUT PRESS TAP.
2. The inlet gas line pressure must be taken at the port marked IN PRESS TAP.
3. Using a 3/16” allen wrench, remove the plugs from the inlet and outlet pressure ports. Connect a 1/8” UPT barbed hose fitting to each pressure port.

Read the inlet gas pressure using the method below.

A. Disconnect the pressure reference hose from the burner box. Using a tee fitting and a short piece of hose, connect the negative side of the manometer to the burner box as described below.

B. Remove one end the 5/16” (7.94 mm) ID flexible tubing over the pressure port on the burner box.

C. Insert the end of the 5/16” (7.94 mm) tubing, that has the 1/8” (3.175 mm) adapter at the end of the tube, in to the 1/8” (3.175 mm) tee.

D. Connect the 1/8” (3.175 mm) tee to the burner box adapter and to the negative side of a U-tube manometer or digital pressure measuring equipment with 2 – 1/8” (3.175 mm) tubes.

E. Use the 5/16” (7.94 mm x 1/8” (3.175 mm) reducing coupling and a 4” (101.6 mm) piece of 1/8” (3.175 mm) tubing to connect the positive side of the manometer to the gas valve pressure reference port. Refer to Figure 40 for connection details.

IMPORTANT: The cap for the pressure regulator must be removed entirely to gain access to the adjustment screw. Loosening or tightening the cap does not adjust the flow of gas.

1. Refer to Figure 39 for location of pressure regulator adjustment cap and adjustment screws on main gas valve.
2. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.
3. Adjust manifold pressure by adjusting gas valve regulator screw for the appropriate gas per the following:

TABLE 15: Nominal Manifold Pressure

NOMINAL MANIFOLD PRESSURE	
Natural Gas (Max)	3.5" w.c. (0.87 kPa)
Natural Gas (Min)	0.5" w.c. (0.15 kPa)
Propane (LP) Gas (Max)	10.0" w.c. (2.49 kPa)
Propane (LP) Gas (Min)	1.6" w.c. (0.40 kPa)

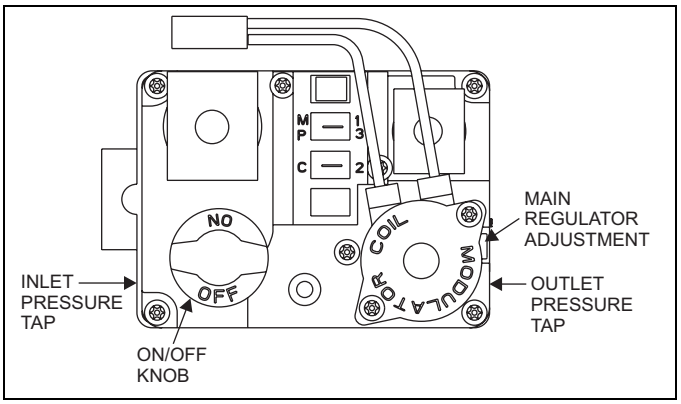


FIGURE 39: Gas Valve

IMPORTANT: If gas valve regulator is turned in (clockwise), manifold pressure is increased. If screw is turned out (counter clockwise), manifold pressure will decrease.

4. After the manifold pressure has been adjusted, re-calculate the furnace input to make sure you have not exceeded the specified input on the rating plate. Refer to “CALCULATING THE FURNACE INPUT (NATURAL GAS)”.
5. Once the correct BTU (kW) input has been established, turn the gas valve to OFF and turn the electrical supply switch to OFF; then remove the flexible tubing and fittings from the gas valve pressure tap and the pressure reference hose from the burner box and replace the pressure tap plugs. Replace the burner box front cover (if it was removed) and place the pressure reference hose back on the gas valve.
6. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved gas detector, a non-corrosive leak detection fluid, or other leak detection methods.

⚠ WARNING

The manifold pressure must be checked with the screw-off cap for the gas valve pressure regulator in place. If not, the manifold pressure setting could result in an over-fire condition. A high manifold pressure will cause an over-fire condition, which could cause premature heat exchanger failure. If the manifold pressure is too low, sooting and eventual clogging of the heat exchanger could occur. Be sure that gas valve regulator cap is in place and burner box to gas valve pressure reference hose is connected.

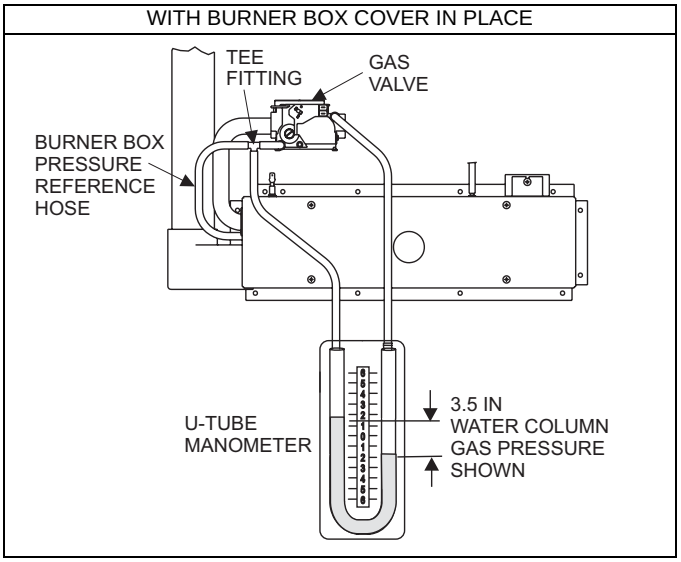

WITH BURNER BOX COVER IN PLACE
TEE FITTING
GAS VALVE
BURNER BOX PRESSURE REFERENCE HOSE
U-TUBE MANOMETER
3.5 IN WATER COLUMN GAS PRESSURE SHOWN

FIGURE 40: Reading Gas Pressure

ADJUSTMENT OF TEMPERATURE RISE

⚠DANGER

The temperature rise, or temperature difference between the return air and the supply (heated) air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations shown in Table 5 "ELECTRICAL AND PERFORMANCE DATA".

*The supply air temperature cannot exceed the **"Maximum Supply Air Temperature"** specified in these instructions and on the furnace rating plate. Under NO circumstances can the furnace be allowed to operate above the Maximum Supply Air Temperature. Operating the furnace above the Maximum Supply Air Temperature will cause premature heat exchanger failure, high levels of Carbon Monoxide, a fire hazard, personal injury, property damage, and/or death.*

The air temperature rise, or difference between the return air temperature and the heated supply air temperature from the furnace, must be within the air temperature rise range shown on the furnace rating plate and in Table 5.

After about twenty minutes of operation, determine the furnace temperature rise. Take temperature readings of both the return air and the heated air in the ducts about six feet away from the furnace, where they will not be affected by radiant heat. Increase or decrease the temperature rise by changing the ATR jumper on the furnace control board. The jumper is factory-set to deliver an air temperature rise near the midpoint of the nameplate temperature rise range. If more air is desired (lower temperature rise), move the jumper to the -10 position. If less air is desired (higher temperature rise), move the jumper to the +10 position.

Do not move the motor wires to different positions on the furnace control board!

ADJUSTMENT OF FAN CONTROL SETTINGS

Cooling - The airflow delivered by the furnace during cooling operation can be adjusted to match the cooling capacity of the A/C condensing unit. This is done by moving the COOL and ADJ jumper on the control board to give the desired airflow.

The COOL jumper has four positions, which will deliver sufficient airflow in cooling mode for the cooling capacities shown in the Table 16. The CFM delivery on each jumper position is shown in Table 17.

The ADJ jumper has three positions which can be used to make further adjustments to the cooling blower airflow. See Table 17 for further information.

TABLE 16: Cooling Airflow - A/C Capacity in Tons

Models	Cool Jumper Position			
	D	C	B	A
60/1200	1-1/2	2	2-1/2	3
80/1200	1-1/2	2	2-1/2	3
80/1600	2-1/2	3	3-1/2	4
100/1600	2-1/2	3	3-1/2	4
100/2000	3	3-1/2	4	5
120/2000	3	3-1/2	4	5

Continuous Fan Operation - The airflow delivered by the furnace during continuous fan operation can be adjusted as desired. This is done my moving the RECIRC jumper on the control board to give the desired airflow.

The jumper has three positions. The "A" position delivers maximum airflow, 100% of the blower capacity. Position "B" delivers approximately 70% of the blower capacity. And Position "C" delivers minimum airflow, approximately 40% of the blower capacity.

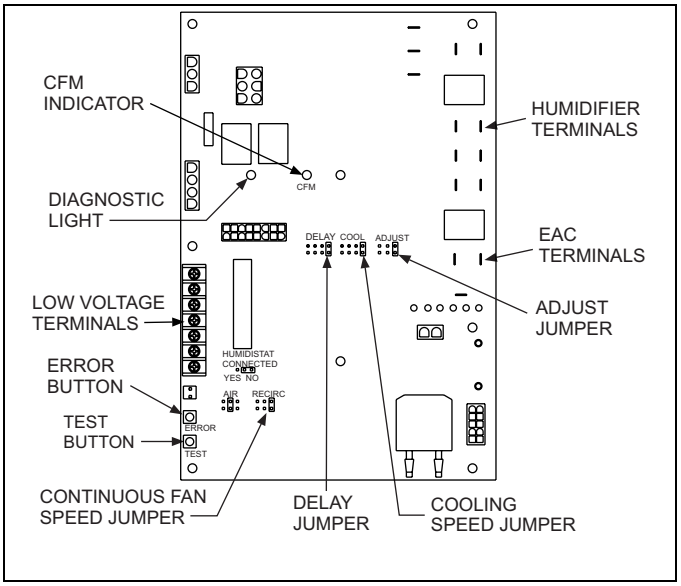


FIGURE 41: Furnace Control Board

Delay Taps Selection

The set of jumper pins on the control board labeled "DELAY" are used to set the delay profiles for the furnace. These can be chosen so as to maximize the comfort and sound levels for various regions of the country.

Tap A is the default profile. It provides a 30-second ramp-up from zero airflow to full capacity and a 30-second ramp-down from full capacity back to zero airflow. Whenever there is a change in airflow mode, such as from low heat to high heat, the motor will take 30 seconds to ramp from one speed to the other.

Tap B is the humid profile. This profile is best-suited for installations where the humidity is frequently very high during cooling season, such as in the southern part of the country. On a call for cooling, the blower will ramp up to 50% of full capacity and will stay there for two minutes, then will ramp up to 82% of full capacity and will stay there for five minutes, and then will ramp up to full capacity, where it will stay until the wall thermostat is satisfied. In every case, it will take the motor 30 seconds to ramp from one speed to another.

Tap C is the dry profile. This profile is best suited to parts of the country where excessive humidity is not generally a problem, where the summer months are usually dry. On a call for cooling the motor will ramp up to full capacity and will stay there until the thermostat is satisfied. At the end of the cooling cycle, the blower will ramp down to 50% of full capacity where it will stay for 60 seconds. Then it will ramp down to zero. In every case, it will take the motor 30 seconds to ramp from one speed to another.

Tap D is the normal profile, best suited for most of the country, where neither excessive humidity nor extremely dry conditions are the norm. On a call for cooling, the motor will ramp up to 63% of full capacity and will stay there for 90 seconds, then will ramp up to full capacity. At the end of the cooling cycle, the motor will ramp down to 63% of full capacity and will stay there for 30 seconds, then will ramp down to zero. In every case, it will take the motor 30 seconds to ramp from one speed to another.

Humidistat

When a humidistat is installed in the system, the “Humidistat connected?” jumper on the control board should be moved to the “YES” position. The cooling airflow will then be reduced by 15% whenever the humidistat indicates high humidity.

SECTION XI: NORMAL OPERATION AND DIAGNOSTICS

NORMAL OPERATION SEQUENCE

The furnace control calculates the optimum firing rate each time the wall thermostat R and W contacts close or open (at the beginning and at the end of each call for heat) based on information from the thermostat and past demand. UNLIKE CONVENTIONAL SYSTEMS, THE WALL THERMOSTAT DOES NOT SIMPLY TURN THE FURNACE ON AND OFF. THE FURNACE CONTROL CALCULATES THE DEMAND AND MAY CONTINUE TO FIRE THE FURNACE DURING PORTIONS OF THE THERMOSTAT "OFF" CYCLE.

When the wall thermostat R and W contacts close, indicating a call for heat, the following sequence occurs:

1. The inducer is energized and ramps up its speed until airflow is proven by the pressure switch and by the pressure sensor on the control board.
2. The hot surface ignitor is energized.
3. After a 17-20 second igniter heatup, the gas valve opens and the burners light.
4. When the control senses that flame is present, the circulating blower starts at low speed.
5. The furnace fires at 70% of full rate for 30-45 seconds, then drops to the minimum (35%) firing rate.
6. The firing rate is automatically adjusted to meet demand, increasing gradually to maximum (100%) firing rate if the thermostat is not satisfied within a defined time.
7. When the thermostat R and W contacts open (thermostat is satisfied) the furnace control recalculates the demand and a new firing rate.
    a. If demand exceeds the minimum firing rate, the burners will continue to fire at a recalculated reduced firing rate, decreasing if the thermostat remains off for a defined time.
    b. If demand does not exceed the minimum firing rate, the burners will shut off immediately.
8. After the burners shut off, the circulating blower will continue to run until the temperature sensor detects that the supply air temperature has dropped to the desired level, which should take from 30 to 90 seconds.

FURNACE CONTROL DIAGNOSTICS

This furnace has built-in self-diagnostic capability. If a system problem occurs, a flashing LED shows a fault code. The LED can flash red, green or amber to indicate various conditions. The LED is located on the furnace control board and can be seen through the clear view port in the lower door of the furnace. To indicate an error condition, the LED will turn on for 1/4 second and off for 1/4 second. The pattern will be repeated the number of times equal to the flash code. For instance, a "six flash code" will be indicated by the LED turning on and off six times. There will be a two second off period between each set of flashes. The flash codes and an indication of their likely causes are listed below:

STEADY OFF - No 24V power to board. Check the 24 volt control circuit fuse on the board. Check the circuit breaker or fuse on the 115 volt supply power to the furnace. Check that the 24 volt transformer.

One Green Flash - Normal Operation with no call for heat.

Two Green Flashes - Indicator for "No error codes in memory". See Diagnostic Fault Code Storage and Retrieval section below.

Three Green Flashes - Indicator for "Error codes cleared from memory". See Diagnostic Fault Code Storage and Retrieval section below.

Rapid Green Flash - Control is in "Factory Speed-up" mode. This mode is used only during factory run-testing of the furnace. To stop this mode, cycle power to the furnace off and then back on.

One Amber Flash - Normal operation with call for cooling.

Two Amber Flashes - Normal operation with call for heat.

Three Amber Flashes - Normal operation, burner is on at end of heating cycle after wall thermostat has been satisfied.

Four Amber Flashes - Heating capacity is reduced due to restriction in the circulating air system. Check for dirty filter or closed registers.

Five Amber Flashes - Heating capacity is reduced due to restriction in the combustion air or vent system. Check for blocked vent/air pipe or clogged condensate drain. Above 4,000 feet altitude, this may also indicate automatic, normal derating for altitude. See page 10 for additional high altitude information.

Rapid Amber Flash - Low flame sense current. Check for dirty or mislocated flame sensor rod.

One Red Flash - Flame is present with no power being supplied to gas valve. This can be caused by a gas valve that is slow to close or that leaks gas through to the burners.

Two Red Flashes - Stuck closed pressure switch. The control confirms that the pressure switch contacts are open at the beginning of each cycle. This could be caused by a faulty pressure switch or by mis-wiring of the pressure switch.

Three Red Flashes - Stuck open pressure switch. This indicates that the pressure switch is open when it should be closed. This could be caused by a faulty combustion air blower, blocked vent pipe, blocked air intake pipe, blocked condensate drain, faulty pressure switch hose or a faulty pressure switch.

Four Red Flashes - High limit switch open or 24 volt fuse is open. This may be caused by a dirty air filter, improperly sized duct system, faulty blower motor, restricted circulating airflow or an open fuse on the control board.

Five Red Flashes - Rollout switch or auxiliary limit switch open. Check the rollout switch on the side of the burner box. It is a manual reset switch. To reset, push the small button in the center of the switch. If it cannot be reset or if the switch trips again, contact a qualified serviceman. Check the limit switch mounted in the combustion air blower housing.

Six Red Flashes - Current failure on modulating gas valve.

Seven Red Flashes - Lockout due to no ignition. The control will try three times for ignition. If flame cannot be established in three tries, the control will lockout for one hour and then will try again to light. Check gas supply, ignitor, gas valve, flame sensor.

Eight Red Flashes - Lockout due to too many flame recycles. This flash code occurs if flame is lost five times during a single heating cycle. This could be caused by a faulty gas valve, low gas pressure, or dirty flame sensor. The control will lock out for one hour and then will try again.

Nine Red Flashes - Reversed line polarity or improper grounding. Check polarity of the incoming power to the furnace. Check the grounding of the furnace, including the transformer ground and the L1 and neutral connections.

Ten Red Flashes - Gas valve circuit shorted. Check gas valve wiring. If correct, replace gas valve.

Eleven Red Flashes - Main blower failure - This flash code occurs when the main limit opens and fails to reclose within five minutes, indicating that the blower motor or blower wheel has failed.

Twelve Red Flashes - ID plug is not present or not connected properly, check for loose plug or loose wires in plug.

Steady On Red - Control fault has been detected or there is 24 volts present without 115 volts. Check that there is 24 volts and 115 volts being supplied to the board. If so, then the board should be replaced.

DIAGNOSTIC FAULT CODE STORAGE AND RETRIEVAL

The control in this furnace is equipped with memory that will store up to five error codes to allow a service technician to diagnose problems more easily. This memory will be retained even if power to the furnace is lost. **Only a qualified service technician should use this feature.**

The control stores up to five separate error codes. If more than five error codes have occurred since the last reset, only the five most recent will be retained. The furnace control board has a button, labeled **"LAST ERROR"** that is used to retrieve error codes. This function will only work if there are no active thermostat signals. So any call for heating, cooling or continuous fan must be terminated before attempting to retrieve error codes.

To retrieve the error codes, push the **LAST ERROR** button. The **LED** on the control will then flash the error codes that are in memory, starting with the most recent. There will be a two-second pause between each flash code. After the error codes have all been displayed, the **LED** will resume the normal slow green flash after a five second pause. To repeat the series of error codes, push the button again.

If there are no error codes in memory, the **LED** will flash two green flashes. To clear the memory, push the **LAST ERROR** button and hold it for more than five seconds. The **LED** will flash three green flashes when the memory has been cleared, then will resume the normal slow green flash after a five-second pause.

TABLE 17: Air Flow Data

HIGH / LOW SPEED COOLING AND HEAT PUMP CFM									
60,000 INPUT - 3 Ton		80,000 INPUT - 3 Ton		60,000 INPUT - 3 Ton		80,000 INPUT - 3 Ton		JUMPER SETTINGS	
CFM		CFM		m³/min		m³/min			
High	Low	High	Low	High	Low	High	Low	COOL Tap	ADJ Tap
1330	900	1310	890	37.7	25.5	37.1	25.2	A	B
1130	800	1100	740	32.0	22.7	31.2	21.0	B	B
1220	850	1220	830	34.6	24.1	34.6	23.5	A	A
1040	730	1000	670	29.4	20.7	28.3	19.0	B	A
1120	770	1090	720	31.7	21.8	30.9	20.4	A	C
920	650	900	610	26.1	18.4	25.5	17.3	C	B
950	660	880	610	26.9	18.7	24.1	17.3	B	C
740	540	680	510	21.0	15.3	19.3	14.4	D	B
860	610	810	580	24.4	17.3	22.9	16.4	C	A
690	540	630	500	19.5	15.3	17.8	14.2	D	A
790	570	730	530	22.4	16.1	20.7	15.0	C	C
630	530	590	500	17.8	15.0	16.7	14.2	D	C
80,000/100,000 INPUT - 4 Ton		100,000 INPUT - 5 Ton		80,000/100,000 INPUT - 4 Ton		100,000 INPUT - 5 Ton		JUMPER SETTINGS	
CFM		CFM		m³/min		m³/min			
High	Low	High	Low	High	Low	High	Low	COOL Tap	ADJ Tap
1660	1110	2210	1480	47.0	31.4	62.6	41.9	A	B
1550	1050	1780	1180	43.9	29.7	50.4	33.4	B	B
1610	1070	2040	1350	45.6	30.3	57.8	38.2	A	A
1440	960	1620	1050	40.8	27.2	45.9	29.7	B	A
1470	990	1840	1250	41.6	28.0	52.1	35.4	A	C
1370	920	1560	1010	38.8	26.1	44.2	28.6	C	B
1290	850	1470	940	36.5	24.1	41.6	26.6	B	C
1130	790	1370	890	32.0	22.4	38.8	25.2	D	B
1230	850	1460	930	34.8	24.1	41.3	26.3	C	A
1050	720	1250	790	29.7	20.4	35.4	22.4	D	A
1110	760	1310	810	31.4	21.5	37.1	22.9	C	C
950	660	1090	690	26.9	18.7	30.9	19.5	D	C
120,000 INPUT - 5 Ton				120,000 INPUT - 5 Ton				JUMPER SETTINGS	
CFM				m³/min					
High	Low			High	Low			COOL Tap	ADJ Tap
2280	1510			64.6	42.8			A	B
1860	1190			52.7	33.7			B	B
2090	1370			59.2	38.8			A	A
1630	1060			46.2	30.0			B	A
1880	1250			53.2	35.4			A	C
1620	1030			45.9	29.2			C	B
1500	960			42.5	27.2			B	C
1410	880			39.9	24.9			D	B
1490	920			42.2	26.1			C	A
1290	790			36.5	22.4			D	A
1360	840			38.5	23.8			C	C
1140	690			32.3	19.5			D	C

All CFM's are shown at 0.5" w.c. external static pressure.These units have variable speed motors that automatically adjust to provide constant CFM from 0.0" to 0.6" w.c. static pressure. From 0.6" to 1.0" static pressure, CFM is reduced by 2% per 0.1" increase in static. Operation on duct systems with greater than 1.0" w.c. external static pressure is not recommended.
NOTE: At some settings, LOW COOL airflow may be lower that what is required to operate an airflow switch on certain models of electronic air cleaners. Consult the instructions for the electronic air cleaner for further details.

NOTES:

1. Airflow expressed in standard cubic feet per minute (CFM) and in cubic meters per minute (m^3/min).

FILTER PERFORMANCE

The airflow capacity data published in Table 17 represents blower performance WITHOUT filters. To determine the approximate blower performance of the system, apply the filter drop value for the filter being used or select an appropriate value from the Table 18.

NOTE: The filter pressure drop values in Table 18 are typical values for the type of filter listed and should only be used as a guideline. Actual pressure drop ratings for each filter type vary between filter manufacturers.

TABLE 18: Filter Performance - Pressure Drop Inches W.C. and (kPa)

Airflow Range		Minimum Opening Size		Filter Type					
				Disposable		Washable Fiber		Pleated	
CFM	m^3/min	in^2	cm^2	In W.C.	kPA	In W.C.	kPA	In W.C.	kPA
0 - 750	0 - 21.4	230	1484	0.01	0.00249	0.01	0.00249	0.15	0.03736
751 - 1000	21.25 - 28.32	330	2129	0.05	0.01245	0.05	0.01245	0.20	0.04982
1001 - 1250	28.33 - 35.40	330	2129	0.10	0.02491	0.10	0.02491	0.20	0.04982
1251 - 1500	35.41 - 42.48	330	2129	0.10	0.02491	0.10	0.02491	0.25	0.06227
1501 - 1750	42.49 - 49.55	380	2452	0.15	0.03736	0.14	0.03487	0.30	0.07473
1751 - 2000	49.56 - 56.63	380	2542	0.19	0.04733	0.18	0.04484	0.30	0.07473
2001 & Above	56.64 - Above	463	2987	0.19	0.04733	0.18	0.04484	0.30	0.07473

APPLYING FILTER PRESSURE DROP TO DETERMINE SYSTEM AIRFLOW

To determine the approximate airflow of the unit with a filter in place, follow the steps below:

1. Select the filter type.
2. Determine the External System Static Pressure (ESP) without the filter.
3. Select a filter pressure drop from the table based upon the number of return air openings or return air opening size and add to the ESP from Step 2 to determine the total system static.
4. If total system static matches a ESP value in the airflow table (i.e. 0.20, 0.60, etc,) the system airflow corresponds to the intersection of the ESP column and Model/Blower Speed row.
5. If the total system static falls between ESP values in the table (i.e. 0.58, 0.75, etc.), the static pressure may be rounded to the nearest value in the table determining the airflow using Step 5 or calculate the airflow by using the following example.

Example: For a 120,000 Btuh furnace operating on high speed blower, it is found that total system static is 0.58" w.c. To determine the system airflow, complete the following steps:

1. Obtain the airflow values at 0.50" & 0.60" ESP.
   Airflow @ 0.50": 2220CFM
   Airflow @ 0.60": 2135 CFM
2. Subtract the airflow @ 0.50" from the airflow @ 0.60" to obtain airflow difference.
   2135 - 2220 = -85 CFM
3. Subtract the total system static from 0.50" and divide this difference by the difference in ESP values in the table, 0.60" - 0.50", to obtain a percentage.
   (0.58 - 0.50) / (0.60 - 0.50) = 0.8
4. Multiply percentage by airflow difference to obtain airflow reduction.
   (0.8) x (-85) = -68
5. Subtract airflow reduction value to airflow @ 0.50" to obtain actual airflow @ 0.58" ESP.
   2220 - 68 = 2152

TABLE 19: Field Installed Accessories - Non-Electrical

MODEL NO.	DESCRIPTION	USED WITH
1NP0680	PROPANE (LP) CONVERSION KIT WITH GAS VALVE	ALL MODELS
1CT0302	CONCENTRIC INTAKE/VENT 2”	60, 80, 100 INPUT MBH
1CT0303	CONCENTRIC INTAKE/VENT 3”	100, 120 MBH
1NK0301	CONDENSATE NEUTRALIZER KIT	ALL MODELS
1HT0901	SIDEWALL VENT TERMINATION KIT 3”	ALL MODELS
1HT0902	SIDEWALL VENT TERMINATION KIT 2”	ALL MODELS
1CB0317	COMBUSTIBLE FLOOR BASE	17-1/2” CABINET
1CB0321		21” CABINET
1CB0324		24-1/2” CABINET
1TK0917	COIL TRANSITION KIT	17-1/2” CABINET
1TK0921		21” CABINET
1TK0924		24-1/2” CABINET

SECTION XII: WIRING DIAGRAM

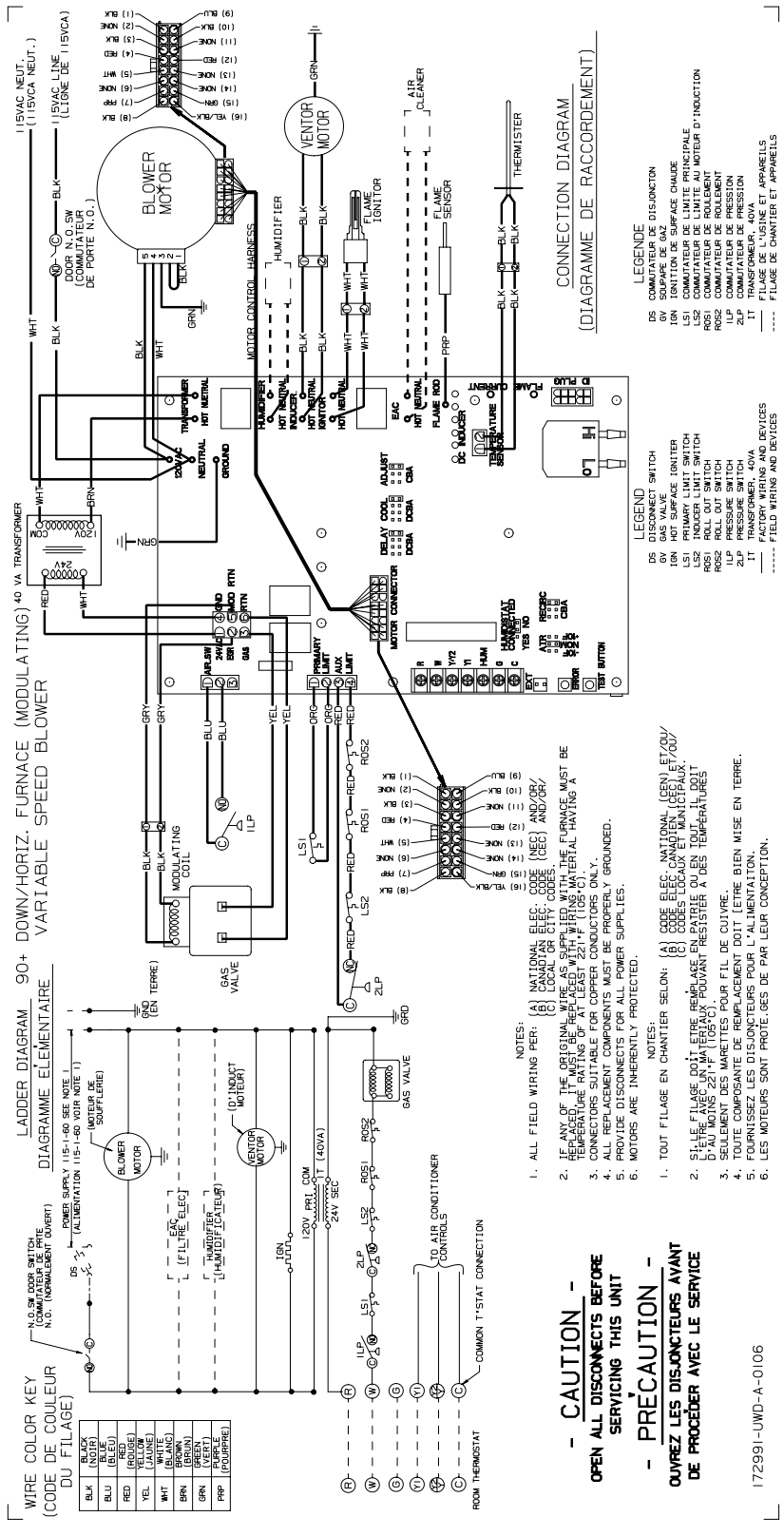


FIGURE 42: Wiring Diagram

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292306-UIM-A-0108
Supersedes: 172987-YIM-C-0606